GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

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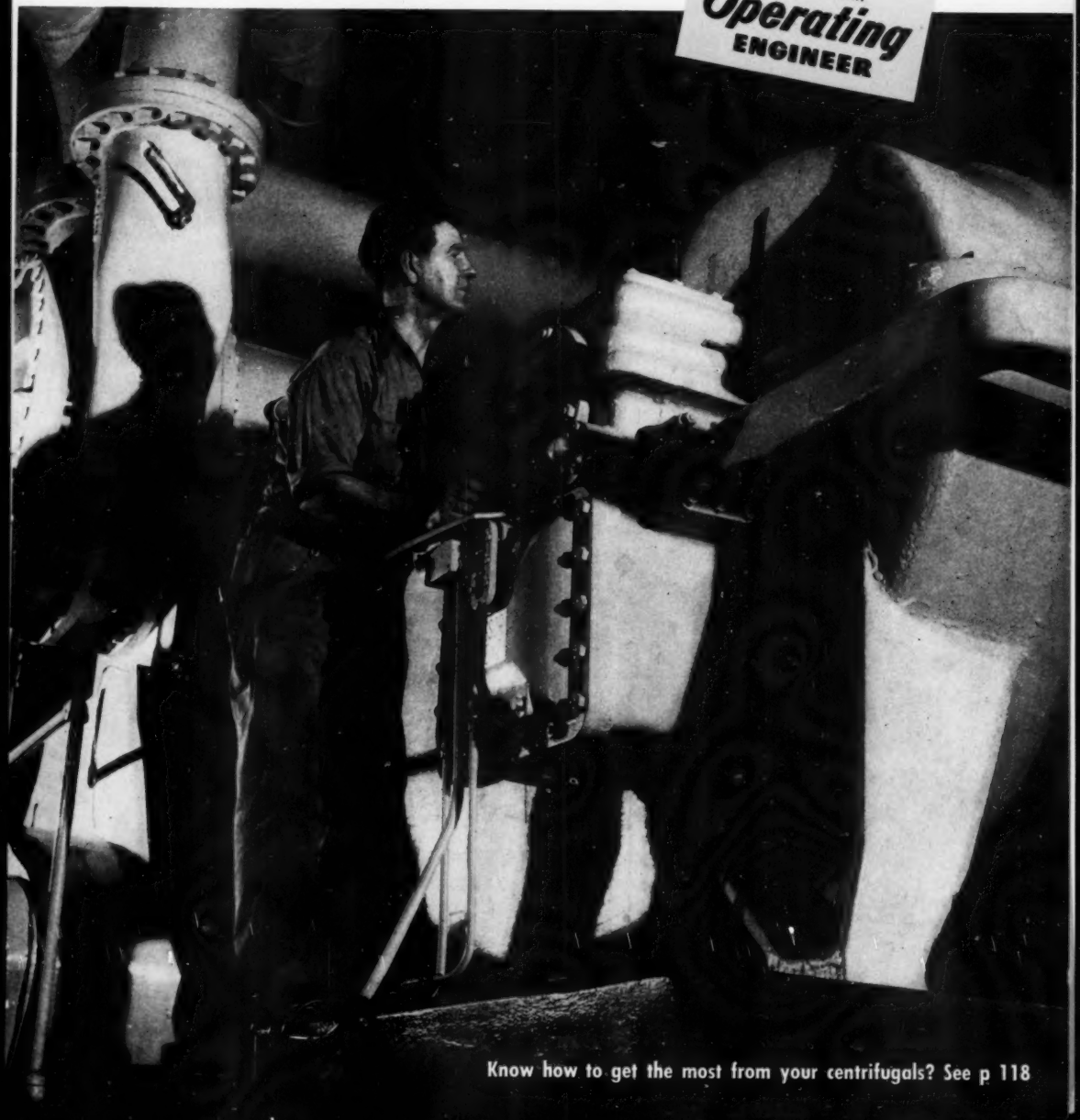
Power

April
1951

A McGRAW-HILL PUBLICATION
combined with
Operating ENGINEER



Know how to get the most from your centrifugals? See p 118

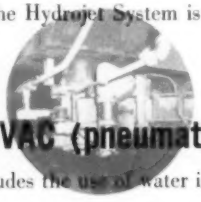
Which system of ASH and DUST disposal is best for your plant...

hydraulic pneumatic

To answer this question, you have to ask: Can the refuse be discharged to permanent or temporary fill at a reasonable distance from the plant? If this is not feasible, can it be discharged to a grab-bucket sump? In either case, the Hydrojet System takes a favorable position.

However, if the material must be stored for truck or railroad car loading, then your solution may be a Hydrojet System, a Hydrovac System, or a combination of the two. The type of system decided on has a direct bearing on the furnace-bottom ash-hopper design.

The HYDROJET (hydraulic) System provides greater flexibility, because a hopper design of the wet type can be used. A pool of water can be provided in which molten or fusing ash can be disintegrated. If it is a wet bottom or slag type generator, then the Hydrojet System is a "must."



The HYDROVAC (pneumatic) System, when used to remove bottom ash, precludes the use of water in the hopper—the ash must be dry. Hence, many plants use the Hydrovac System only to remove fly-ash and dust.

No matter what your ash and dust removal problems are, you can be sure of getting the best system if you depend on the judgement of our experienced engineers.

ASH

THE ALLEN-SHERMAN-HOFF CO.

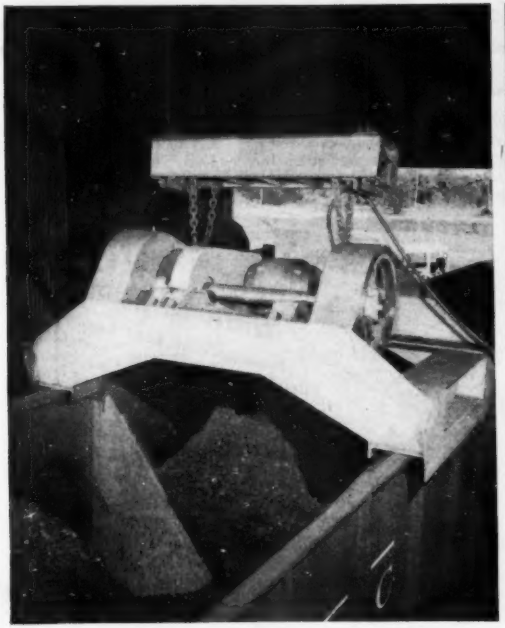
227 South 15th Street, Philadelphia 2, Pa.

Offices and Representatives in Prinicipal Cities

LINK-BELT Car Shakers and Rotary Dumpers

empty railroad cars faster...

...more gently...at lower cost



IT'S EASIER ON CARS. . . thanks to exclusive low-frequency vibration. And the Link-Belt Car Shaker also has a much lower noise level. Positive action gets most hopper bottom cars "broom-clean" in a few minutes. Especially good for damp, sticky materials. Write for Book 2345.

UNLOADS GONDOLAS IN 90 SECONDS or less (including return to upright position)! Simple, automatic, fool-proof—Link-Belt Rotary Car Dumper can be operated by unskilled labor. Takes all types of open top cars . . . up to 90-ton capacity.

Get an unbiased recommendation for the right type of car unloader for your needs

Whether you empty a few gondola cars a day or hundreds—Link-Belt has equipment designed to do the job with maximum efficiency. Shortages of manpower, demands for ever-increasing production—both emphasize the necessity for mechanized, push-button car unloading.

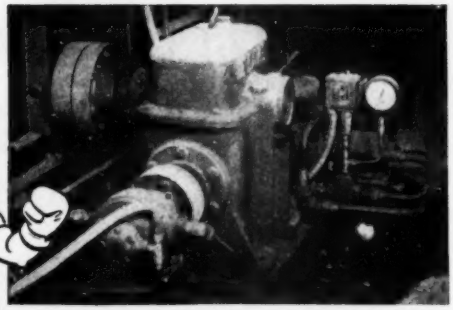
Link-Belt's low-frequency Car Shaker meets the needs of smaller users. While for larger operations, Link-Belt's automatic Rotary Car Dumper offers tremendous capacity. Both are engineered by the leader in materials handling . . . each does a better, more economical job, faster, for your particular requirements.

LINK-BELT

CAR SHAKERS and ROTARY DUMPERS

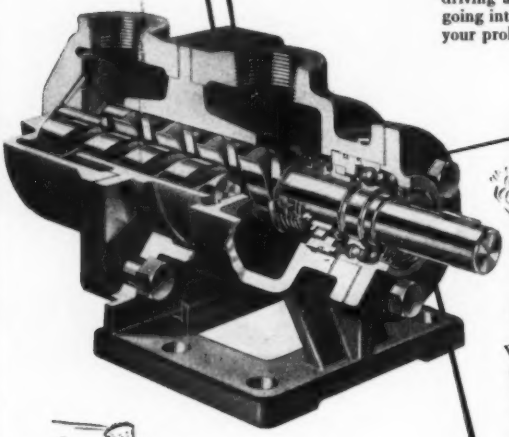
LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in principal cities. 12,320

De Laval products at work!



Tough service?... You bet!

0 to 800 rpm in 8/10 Second . . . 26 Times per Minute. And this De Laval speed reducer takes it and likes it. This particular unit is driving a conveyor belt that automatically feeds and measures billets going into a shear. If you are rough on reducers in your plant, tell your problems to one of our power transmission engineers.



What do you want to pump?

Molasses, Glue, Lard, Soya Oil, Film Dope, Corn Syrup, Vegetable Oil, Paste, Fuel Oil, Shortening, Resin, Varnish, Linseed Oil, Viscose Rayon, Liquid Latex . . .

We frankly don't know all the other products that an IMO can pump, but if you want a better way to transfer fluids like these from one place to another, chances are an IMO can do the job for you. The IMO is a screw-type rotary pump. Its axial flow design permits liquids to be pumped close to the axis of the rotor. This means low liquid velocity through the pump and quiet pulsation-free flow. Capacities range to 1000 gpm at 500 psi and 150 gpm at 1500 psi.

There's a new idea here!

We've simplified the already simple centrifugal pump! Our new GS pump is designed so that every working part . . . every part subject to wear, is contained in one easily replaced unit rotor assembly. Through our Service and Exchange Plan new rotor assemblies are available for immediate shipment from conveniently located stocks throughout the country.

This means good service, and if maintenance ever does become necessary, all you have to do is remove the cover and end plate bolts, lift out the old rotor and drop a new one in place. *It's that easy!* Capacities to 400 gpm — heads to 230 feet.

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

50th DE LAVAL Anniversary

Power

combined with Operating Engineer

APRIL 1951 VOLUME 95 NO. 4

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(Member ABC and ABP)

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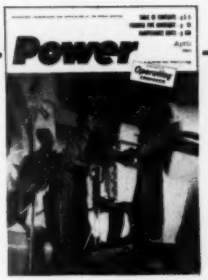


CENTRIFUGAL COMPRESSORS find ever wider use, particularly in today's big air-conditioning installations. And the bigger the plant, the bigger the dividends from topnotch operation and maintenance. Hence the series by James Manning of Carrier Corporation (p 118, this issue).

To dramatize these articles, ace photographer Dick Wolters shot our cover in the 1950-ton plant of Manhattan's new 100 Park Ave building (POWER, Aug 1950, p 90). There we found engineers who are not only helpful to editors and photographers but tops in the very job we're talking about—operating big centrifugals.

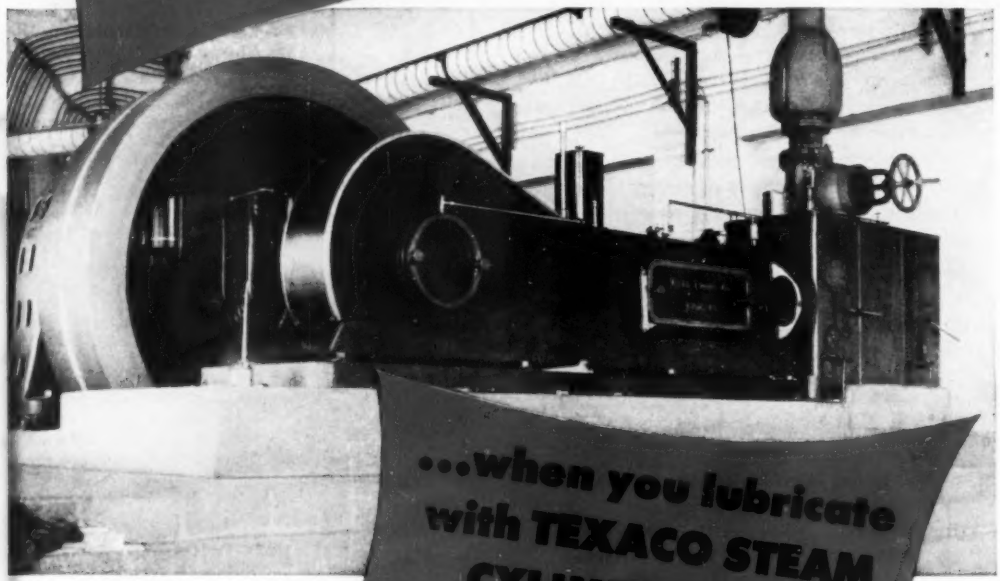
Next month . . .

- The old gag "It isn't the heat, it's the humidity" seems to be getting a new twist in the boiler room. Tests in a number of plants show that, when stokers are supplied with humidified draft air, fireside deposits on boiler tubes are reduced. Read our roundup on this new angle in May.
- Timed to spring's first warm breeze, the insulation series moves over on the low-temperature side with a comprehensive article on cork for cold-storage rooms and pipes—how to apply it and keep it in tiptop shape.
- Modern dust collectors catch tons of flyash before it pollutes our atmosphere. For years, researchers have been trying to find uses for this too plentiful material so disposal may be made less costly or even profitable. Now some of the many schemes begin to look good. For a quick picture, see bibliography in May.
- Got lots of motor controllers in your plant? Want to keep them in the pink? Next issue has the dope.

. . . and future months

- Practical answers to your questions on automatic sprinkler systems.
- Part II of the new POWER Handbook is now scheduled for July. At that time, we'll have reprints of both parts bound, for your convenience, as a single book.

NEW LIFE FOR YOUR STEAM ENGINES



...when you lubricate with TEXACO STEAM CYLINDER OILS

Regardless of age, size or operating conditions, your steam engines will run better with Texaco steam cylinder oils. There is a complete line to assure maximum performance and minimum maintenance costs under all conditions. Here's how it's done:

Texaco steam cylinder oils atomize completely, coat cylinder walls and pistons with a tough, adhesive lubricating film that resists wear, wash-off and extreme heat. These oils assure steam-tight rings . . . smoothly functioning valves . . . longer engine life . . . greater economy.

If steam is used for processing, lubricate with the Texaco steam cylinder oil designed to separate rapidly from exhaust and condensate.

A Texaco Lubrication Engineer will gladly help you to better steam engine operation through proper lubrication. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Steam Cylinder Oils

FOR ALL OPERATING CONDITIONS

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. See newspaper for time and station.

Power

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...with Power readers...

HANDBOOK "TOPS" . . .

Your new POWER *Handbook is even better than the first one, which I've used for years. In fact, it's tops! Will you have reprints of it? I'd like some for a few of my associates.*

Detroit, Mich. J R HEDGES

Yes, Mr Hedges, we'll have reprints of the Handbook. But to make it most convenient and useful we want to put both parts under a single cover. So we'll not be ready with these until July, when Part II will be published.—*Ed.*

ENGINEERS FOR DEFENSE . . .

In your February editorial . . . you state that the Engineering Manpower Commission of EJC is urging that students be permitted to complete their education, but it appears they will not be so fortunate. Engineering classes are rapidly being depleted by the threat of draft into the army and by the calling up of reserves.

My son is the example. His draft classification of 2A defers his being called up for a physical examination until June 15. There definitely is no provision for student deferment after June 15. He may use the period from May 15 to June 15 to enlist in the service branch of his selection, but it is also definite that quotas will be filled then in all other branches. The result will be that he will receive a draft call into

(*Continued on page* 204)

...lines and bylines

DIESEL CONTROLS looked like a subject that hadn't had the attention it deserved, so we planned a series on it. When we cast about for an author, the answer was obvious—Edgar J Kates, dean of consultants in the field.

Edgar J Kates

Ed's been in the diesel game ever since he graduated from Columbia in 1911—40 years. For 15 of them, he was with DeLaVergne Machine Co, a pioneer builder, winding up as chief engineer. Back in 1926, he decided to put his intimate knowledge of engines to work on the application side. So he hung out his shingle as a consultant. In 25 years of it, he's designed innumerable plants here and abroad. Among them was the first fully automatic diesel plant to be put into operation.

Ed liked our idea for a series of articles and dug in with a will. The result is an even more complete and authoritative treatment than we visualized. The current piece (pp 80-83) tells how to guard the engine's lubrication system. Watch for more!

MARINE ENGINEERS sooner or later decide to put down roots ashore. When they do, they usually bring with them self-reliant shipshape habits that make a power plant tick like a good watch. Hank Holz is no exception.

C Henry Holz

From a start in a harbor-tug boiler room, Hank branched out into deep-sea tugs, tankers and merchant ships. In 10 years from 1929 to 1939, he sailed all the world's seas, earned a chief's license. A brief spell in shore plants gave him a taste of landlubber life but war demand for merchant shipping called him back to sea in 1940. The Navy needed topflight seagoing engineers even more than the merchant marine, so 1943 saw Hank in the Pacific campaigns as engineering officer on USS Blue Ridge.

Ashore again, Hank signed on at Columbia University on Jan. 1, 1946. To see how he's taken hold in their plant, turn to p 96.

AIR CONDITIONING seemed a far cry to Leonard Phillips when he graduated from Polytechnic Institute of Brooklyn and started life as a chemical development engineer. He didn't know that his job with the Dry Ice Corp of America would lead him on a tangent into refrigeration and then air conditioning. It did, so much so that he wound up with his own contracting and consulting business.

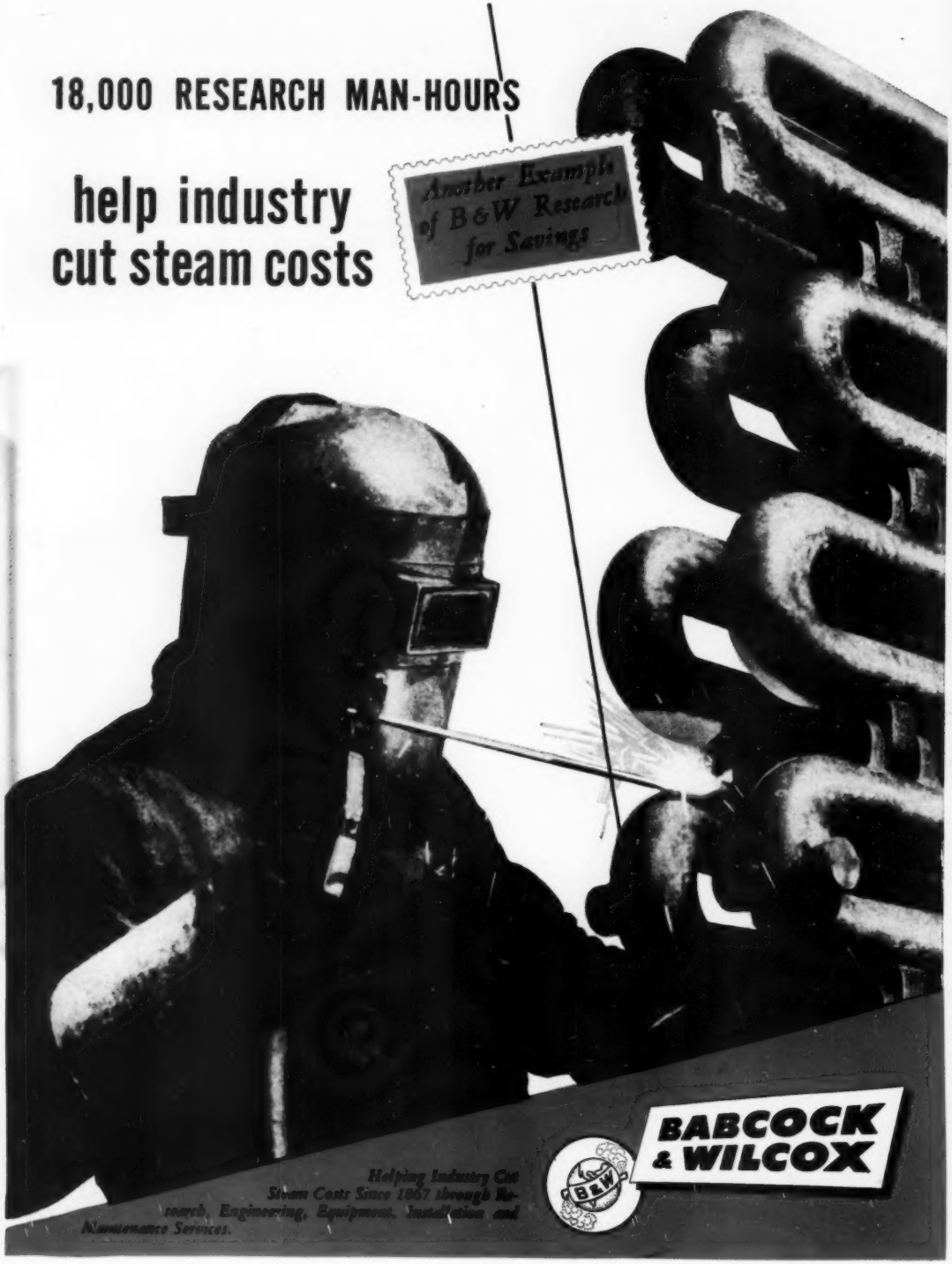
Leonard R Phillips

During World War II, Anemostat Corp of America called Phillips in to work on aircraft heating and wing anticing. In charge of research and development for them, he has made many important contributions to the art of air diffusion, authored many technical papers. One of his prime interests is the testing and balancing of air-conditioning systems, on which he writes in this issue. For his intensely practical pointers, see p 88.

18,000 RESEARCH MAN-HOURS

help industry cut steam costs

Another Example of B&W Research for Savings

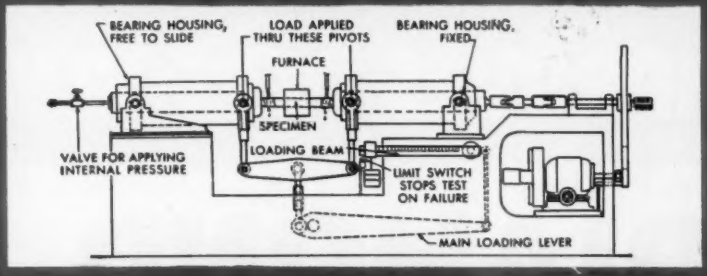


Helping Industry Cut Steam Costs Since 1867 through Research, Engineering, Equipment, Installation and Maintenance Services.

BABCOCK & WILCOX

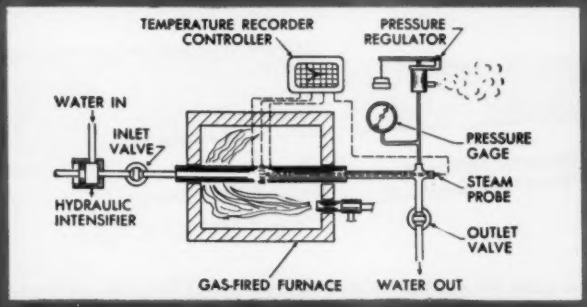
ROTATING BEAM FATIGUE MACHINE

Designed and built by B&W, this apparatus is used to observe fatigue of welded joints under simulated operating conditions: internal pressures to 4000 psi, temperatures to 1400 F, and variable stresses.



CYCLIC QUENCH APPARATUS

Also designed and built by B&W to test effects of repeated quenching on welded specimens at 1050 F and 2500 psi—i.e., actual boiler operating conditions of highest temperature-pressure combination now in service.



Steel—basic in industry—assumes many forms to meet the increasingly severe conditions of modern boiler operation. For example, B&W uses eight or more different steel analyses to obtain optimum dependability, service life, and economy for their high-pressure, high-temperature units.

These Steels—individually, and under conditions each must meet—are stable, tough, flexible, and strong. However, when welded together, they tend to become intractable . . . creep, flow, stretch, warp, harden, crack, and otherwise change at the welded joints to a dangerous and costly degree. B&W is constantly seeking improved methods of welding—to curb these capricious traits of modern alloys . . . and to *help industry keep power costs down.*

For Example: B&W is continuing a three-year-old project, involving some 18,000 research man-hours, on joining widely dissimilar alloys in tubular form. Findings have already produced new methods of control and new welding techniques that are measurably superior to any used before. They add much to the assurance of dependable B&W boiler service at temperatures to 1050 F and pressures as high as 2500 psi.

This Sort of Creative Research in problems of boiler design and construction is an 80-year-old story at B&W. Perhaps it's just what is needed to bring *your* current steam-generating problem to a profitable solution.

G-5137

Mechanically Operated Valve

IMPROVES PERFORMANCE

OF DIAMOND MODEL IK

LONG RETRACTING SOOT BLOWER

The valve now being used on Diamond Model IK Long Retracting Blowers is actuated mechanically by the carriage that projects and retracts the lance tube . . . as shown by the photographs at the right. Opening and closing of the valve is positive . . . dependable . . . accurate.

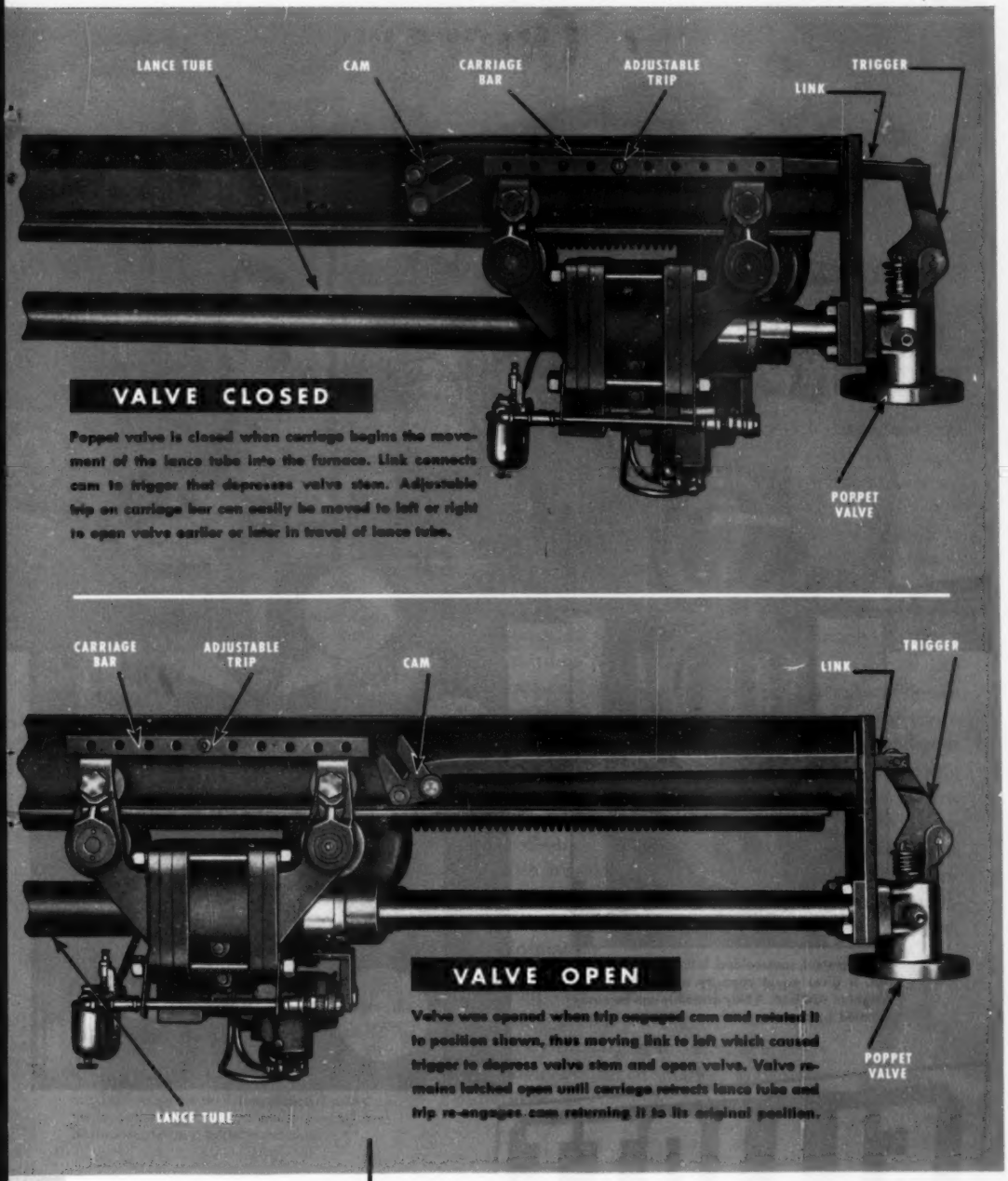
Note the simplicity of the mechanism. Ample adjustment is provided to permit valve operation to be set at the proper point for each individual blower. This valve has very low pressure drop and is suitable for either steam or air blowing; it has the exclusive Diamond adjustable pressure control unit for selection of blowing pressure to meet individual blower needs. This mechanically operated valve has been in field operation on many IK Blowers in severe central station service for the past two years. Results have been so satisfactory that it is now standard on IK Blowers.

Air motor operated unit shown; also available electric motor operated.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO

Diamond Specialty Limited • Windsor, Ontario

4467


LANCE TUBE
CAM
CARRIAGE BAR
ADJUSTABLE TRIP
LINK
TRIGGER
POPPET VALVE
VALVE CLOSED
Poppet valve is closed when carriage begins the movement of the lance tube into the furnace. Link connects cam to trigger that depresses valve stem. Adjustable trip on carriage bar can easily be moved to left or right to open valve earlier or later in travel of lance tube.
CARRIAGE BAR
ADJUSTABLE TRIP
CAM
LINK
TRIGGER
POPPET VALVE
LANCE TUBE
VALVE OPEN
Valve was opened when trip engaged cam and rotated it to position shown, thus moving link to left which caused trigger to depress valve stem and open valve. Valve remains latched open until carriage retracts lance tube and trip re-engages cam returning it to its original position.

ADVANTAGES

Positive valve action

Simple and rugged mechanical linkage

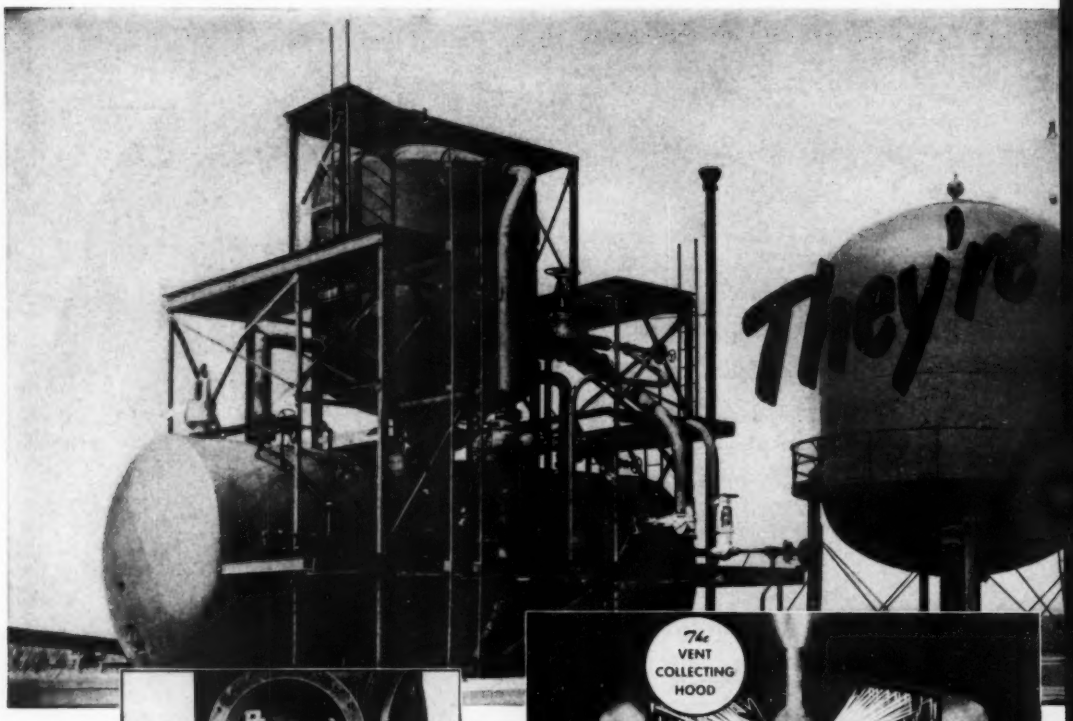
Adjustable valve operating position

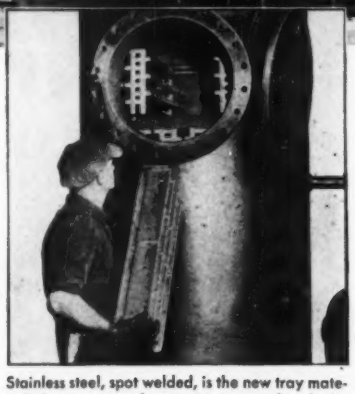
No critical adjustment for tight valve seating

Completely adaptable to steam and air blowing, interchangeably

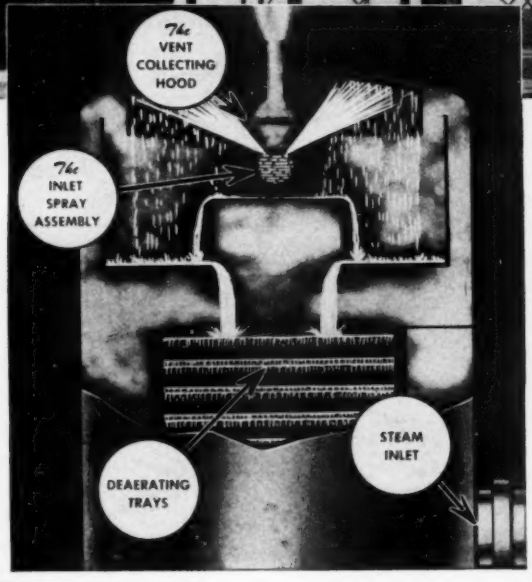
Low pressure drop

Adjustable pressure control on each individual blower





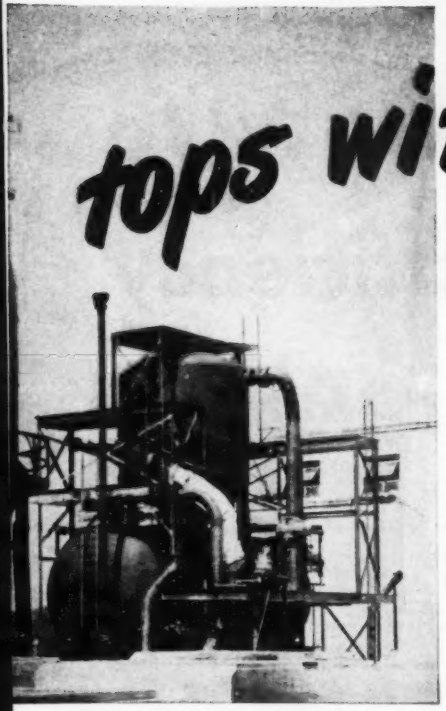
Stainless steel, spot welded, is the new tray material. It gives equal capacity at one-fourth the weight of cast iron. A tray assembly can be easily handled by one man without lifting equipment.



ELLIOTT COMPANY

Deaerator and Heater Dept.

JEANNETTE, PA.



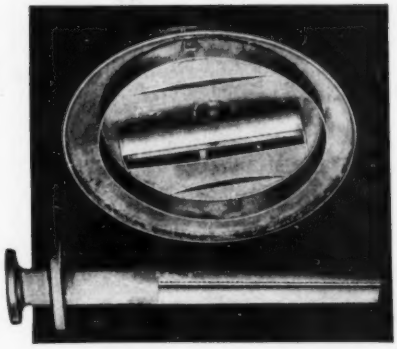
tops with utilities!

ELLIOTT
Deaerating Heaters

The distinguishing mark of any new important station is apt to be the newest type Elliott deaerating feedwater heater mounted upon its storage tank, silhouetted against the sky.

The installation at the left is typical—a fine new Southern Station with one 100,000 kwh unit already operating, a second similar unit under construction and two additional units planned. Two of the Elliott deaerating heaters, of 975,000 lb per hr, are already installed, and a third on order.

These new type Elliott deaerating heaters have design elements which eliminate a large percentage of the maintenance formerly necessary. The tubular vent condenser is replaced with an inlet spray unit and vent collecting hood which normally require no maintenance. Trays, formerly of heavy cast iron, are now of fabricated stainless steel—light and corrosion-proof. Non-corrodible materials are used everywhere undeaerated water contacts the metal. All in all, the new unit is characteristically Elliott in conception, in engineering excellence, in performance.



This is the unit that takes the place of the tubular vent condenser with its many small tubes, formerly mounted on top of the deaerating heater shell. The inlet spray unit and vent collecting hood are inside the shell, (see section drawing on the opposite page). Saves maintenance, saves headroom, makes a better installation.

The complete description of the Elliott deaerating heater will explain why it is favored by the largest utilities, as well as in smaller industrial plants. Write for Bulletin N-16.

N-1001

Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
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HALF CENTURY OF 1901 E Co 1951 POWER PROGRESS

How to the Efficiency Boiler-Room

Before you get steam you've got to spend dollars—so dollars are a form of energy.

And if your boiler-room dollars are invested in equipment that isn't working efficiently, economically, your "investment" is poor.

That's where co-ordinated controls by Bailey can help. Here's why they'll increase your "boiler-room investment efficiency":

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

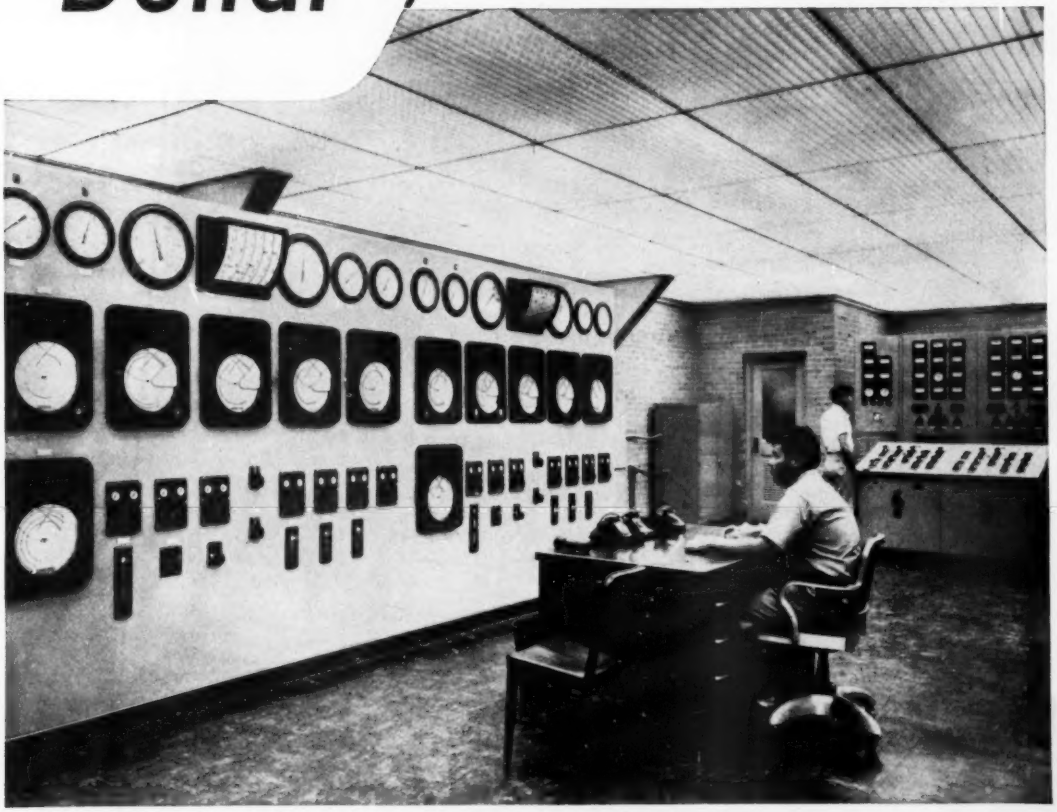
For better "boiler-room investment" efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

III-1

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

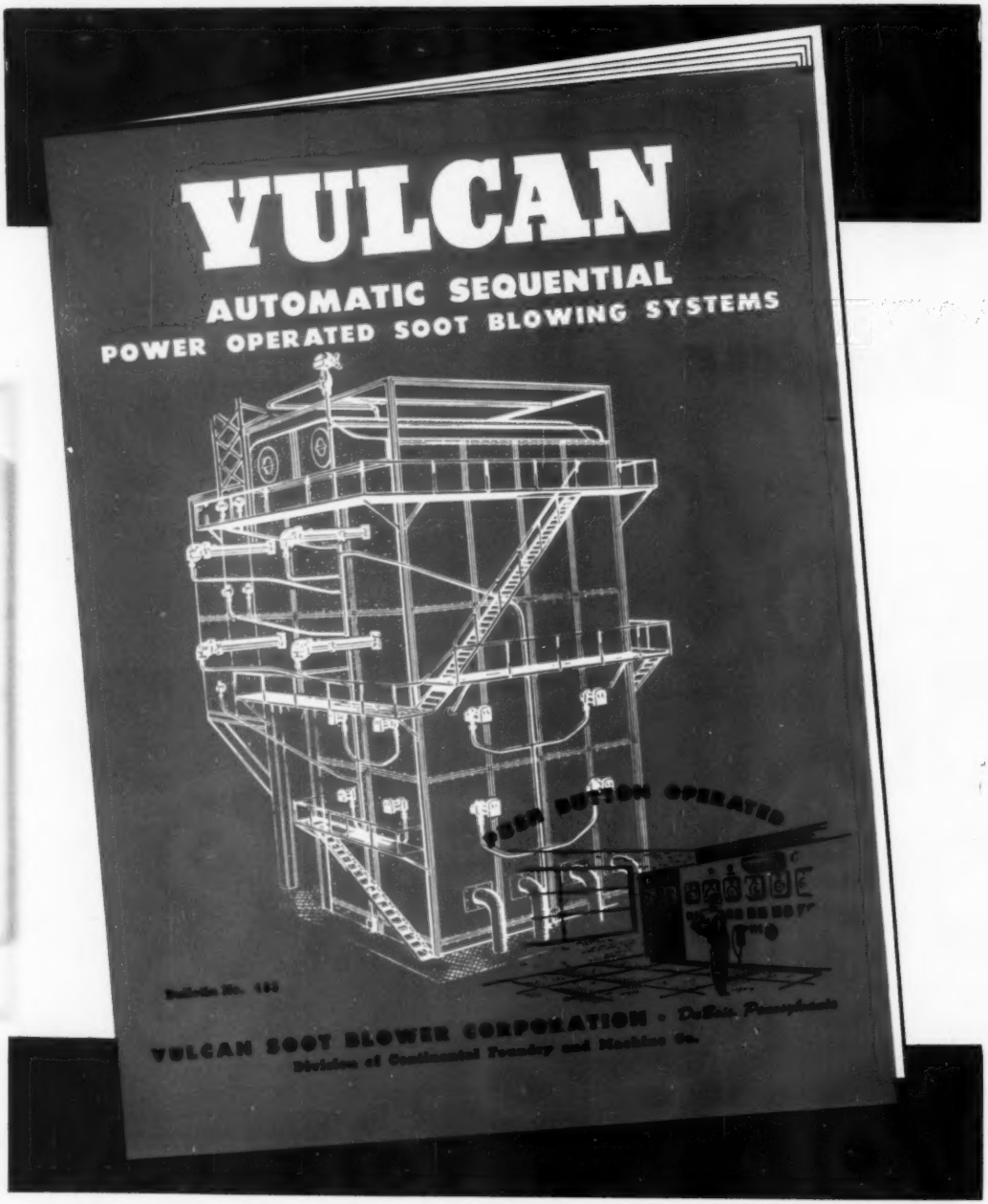
INCREASE of YOUR Dollar



These Bailey Boiler Controls for Combustion, Feed Water, and Steam Temperature insure efficient operation of two 450,000 lb per hr, 1000 psi, 900 F, gas and oil fired boilers.

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY, LIMITED • MONTREAL, CANADA


VULCAN
AUTOMATIC SEQUENTIAL
POWER OPERATED SOOT BLOWING SYSTEMS
PUSH BUTTON OPERATED
VULCAN SOOT BLOWER CORPORATION • Dallas, Pennsylvania
Division of Continental Foundry and Machine Co.

VULCAN Automatic

YOURS

for the Asking---

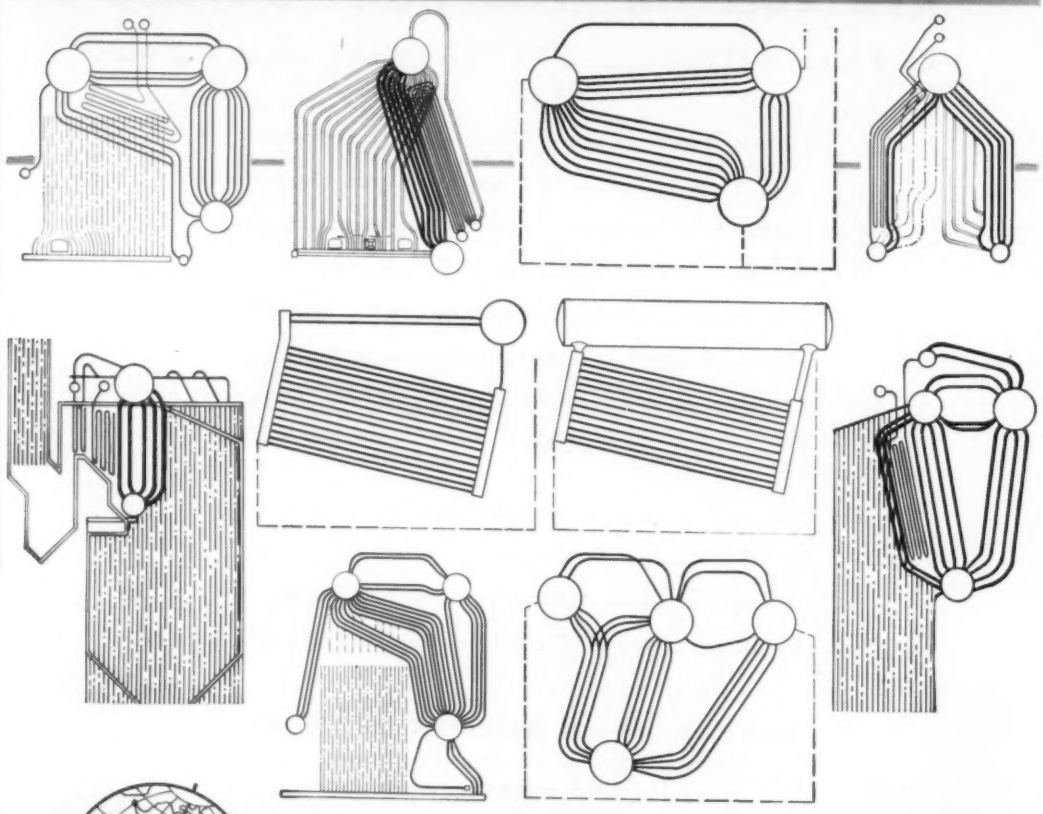
NEW BULLETIN TELLS HOW YOU CAN CLEAN BOILERS BETTER---*at Lower Cost*

Here are sixteen pages of facts worth money to you. They tell how you can clean your boilers better with less labor—and use less steam or air in the process. These benefits tell why more and more of the important new central stations are installing Vulcan Automatic-Sequential Soot Blowing Systems—why Vulcan offers better cleaning at lower cost.

Ten drawings of typical installations are shown, to help you see how a modern Vulcan Automatic System could be applied to your boilers. Write today for a copy of this helpful new Bulletin 483.

VULCAN SOOT BLOWER DIVISION
Continental Foundry & Machine Company
DUBOIS, PENNSYLVANIA

COPES



COPES

BOILER FEED

•The Oldest Name...

•Greatest Experience...

•Most Installations...

BOILER SAFETY Depends on Correct Water Level

NEVER forget this: Your operation—whatever your boiler size or type—is safe only when there is correct water level in the drum. Too low a level could cause loss of tubes. Too high a level could cause carry-over to damage prime movers or process.

To be sure of correct water level, no matter how severe your operating conditions, rely on COPES—the oldest name in boiler feed control. Experience, with more than 75,000 installations since 1913, guarantees effective, economical feed water control.

NORTHERN EQUIPMENT DIVISION
Continental Foundry & Machine Company
411 GROVE DRIVE, ERIE, PENNSYLVANIA

***Headquarters for* Feed Water Regulators, Pump Governors, Differential Valves, Level Controls, Hi-Low Alarms, Reducing Valves, Desuperheaters**

WATER REGULATION

6 reasons why

...Industry after Industry has selected the VERTICAL-UNIT BOILER

PARTIAL LIST OF INDUSTRIES THAT HAVE SELECTED THE VU-10 BOILER

AUTOMOBILE
BAKERIES
BREWERIES
CEMENT
CHEMICAL
COLD STORAGE
DAIRIES
DISTILLERIES
FOOD
GLASS
HOSIERY
HOSPITALS
INSTITUTIONS
LAUNDRIES
LEATHER
LINOLEUM
MACHINERY
METALS
OIL
PACKING
PAINT
PAPER
RAILROADS
RUBBER
SCHOOLS
STEEL
SUGAR
TEXTILE
TOBACCO
UTILITY

A glass plant in Ohio . . . a chemical plant in West Virginia . . . a floor covering plant in Delaware . . . plant after plant, representative of virtually every branch of industry, has chosen the C-E Vertical-Unit Boiler, Type VU-10 to meet its particular steam requirements. Here are six important reasons for the VU-10's industry wide acceptance:

Balanced Design— Not one or two features for special needs, but a *completely balanced design* that adapts itself to many conditions. A design in which each element is coordinated with every other for top performance.

Efficient Performance— The VU-10 has high efficiency over a wide range of output, produces steam of satisfactory quality at all ratings and responds to rapid load swings . . . all characteristics of advantage to many industrial plants.

Easy Operation and Maintenance— The VU-10 is simple to operate and maintain — especially advantageous for plants with limited operating and maintenance forces. All parts readily accessible for such cleaning and maintenance work as may be necessary.

Choice of Fuels and Firing— In addition to its wide adaptability, the VU-10 permits you to choose the one *best* method of firing for the fuel and load conditions of *your* plant.

Lower Cost— The standardized balanced design of the Vertical-Unit Boiler effects economies in engineering, fabrication and erection which are passed on to you in lower first cost.

Unified Responsibility— The Vertical-Unit Boiler is a complete unit . . . boiler, furnace setting, fuel-burning equipment, controls, forced draft . . . bringing you the added benefit of one contract, one guarantee and one responsibility.

• • •

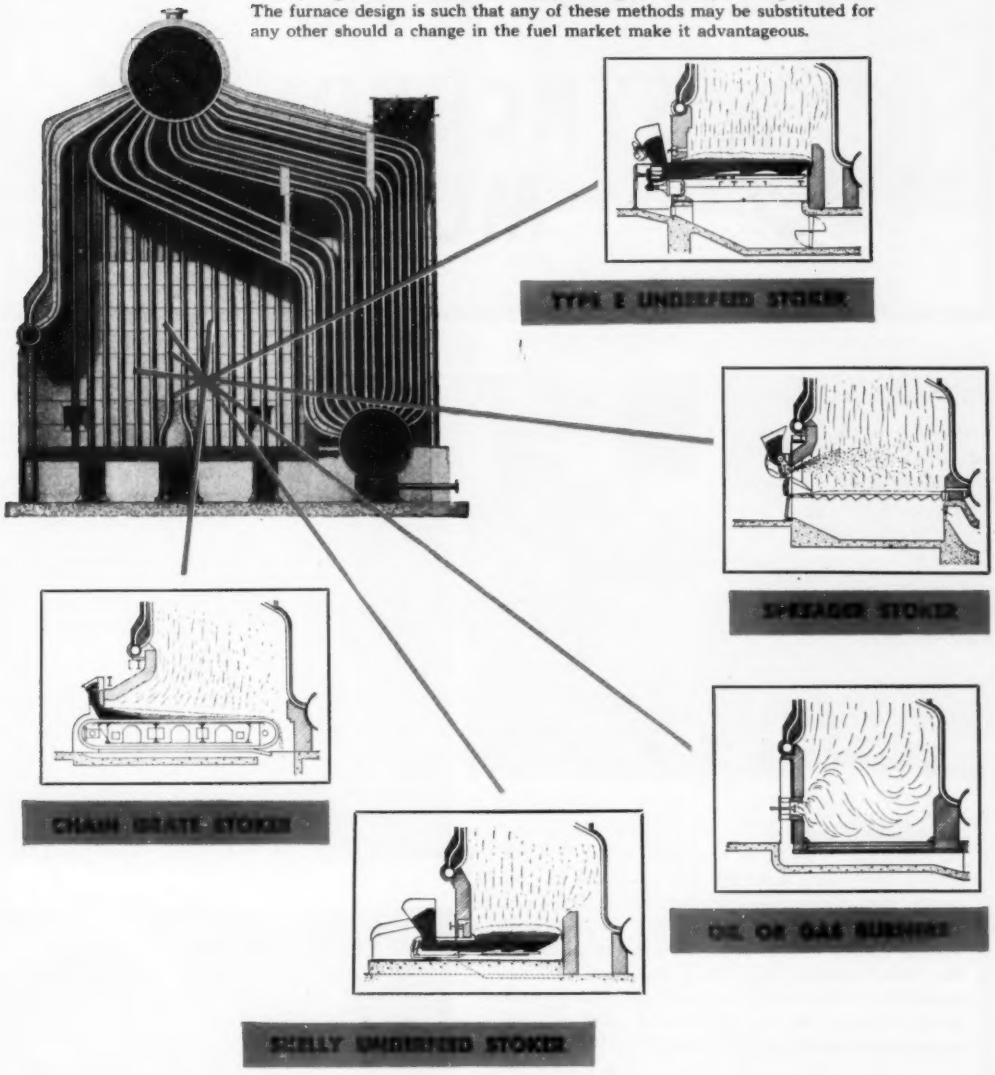
The design, construction and operating features of the VU-10 meet all the requirements of a modern industrial plant. Small wonder so many diverse industries select this unit for their steam needs. If your requirements fall within the capacity range, 10,000 to 60,000 lb of steam per hour, it will pay you to investigate the VU-10. Our engineers will welcome the opportunity to discuss the matter with you or your consultants at your convenience. B-381

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

For every fuel market and every type of load there is *one best* method of firing. The selection of that *one best* method for the fuel and load conditions of a particular plant calls for judgment based on broad experience and free from any incentive to favor one type of equipment over another.

The Type VU-10 Boiler is designed for five methods of firing – spreader stoker, single-retort underfeed stoker, chain grate stoker, oil or gas burners. The furnace design is such that any of these methods may be substituted for any other should a change in the fuel market make it advantageous.



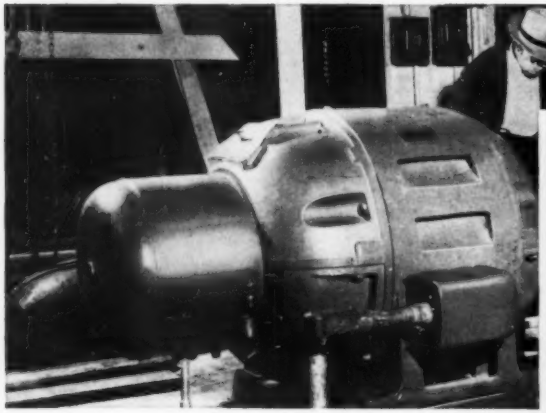
— SUPERHEATER, INC.

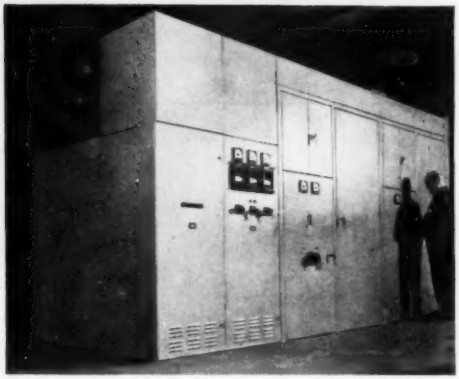
200 MADISON AVENUE, NEW YORK 16, N. Y.

CE

DEPENDABILITY where it counts

SYNCHRONOUS MOTORS

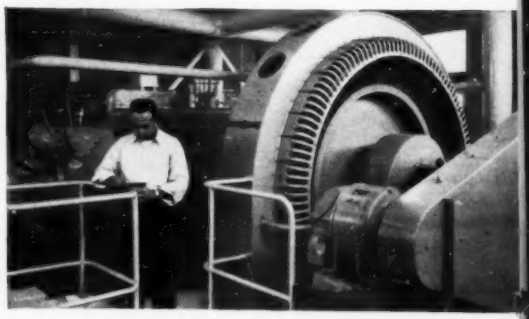




Dependability and long life are a must in water-pumping equipment. Cohoes, N. Y. selected a G-E Tri-Clad* 500-hp synchronous motor for their raw-water pumping station. And as protection against a short-circuit capacity of 60,000 kva, Cohoes selected G-E Limitamp high-voltage control. Besides providing accurate control for the motor, Limitamp clears shorts from the line in less than half a cycle—before damage can come to either motor or control. Ask your nearest G-E sales office for more information on Limitamp control.

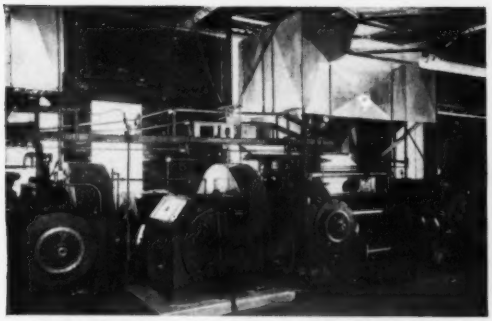
* Reg. U. S. Pat. Off.

ON CRITICAL PUMPING OPERATIONS

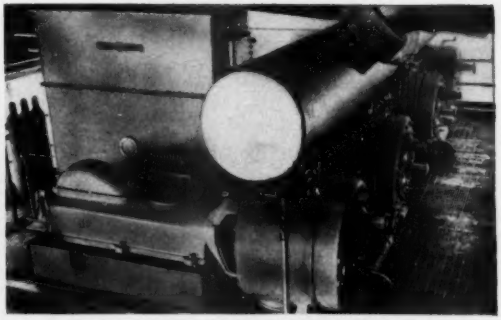


Driving compressors in gas pumping station serving hundreds of homes, motor requirements were—dependability and low cost. This G-E 1500-hp synchronous motor scores on both counts.

FOR SPECIAL SERVICE CONDITIONS

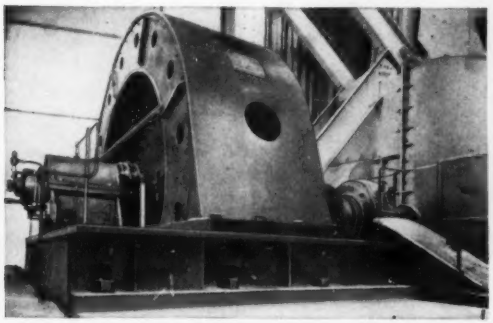


Corrosive, dust-laden atmosphere has no effect on this externally ventilated synchronous motor. Installed in a plastics mill, it's typical of the special enclosures that can be designed to meet almost any operating problem.

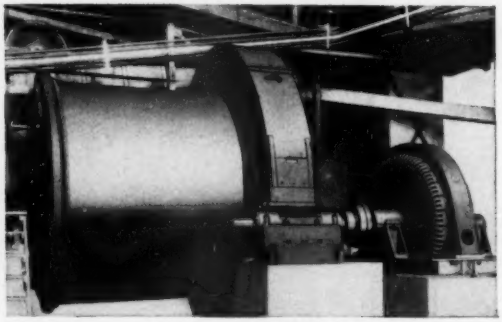


These gas compressors created a hazardous atmosphere for motor operation. The external enclosure of this 300-hp, G-E synchronous motor is filled with an inert gas to provide reliable operation.

FOR TOUGH JOBS



A motor must be rugged to drive a large wood chipper capable of chewing 40-inch diameter logs into small pieces. This G-E synchronous motor, with rigid, box-type construction will give years of dependable service—on a *tough* application.



To meet the rough test of driving a ball mill, this mining company chose a G-E high-torque synchronous motor rated at 600 hp. It's given them years of dependable operation and still going strong.

SAVE MONEY, TOO

It's a fact . . .

Lower Operating Costs,
higher operating efficiency.

Lower Initial Cost
including control and exciter—for many ratings.

Reduced Demand
and release of needed generating capacity.

Reduced Power Rates
for improved power factor.

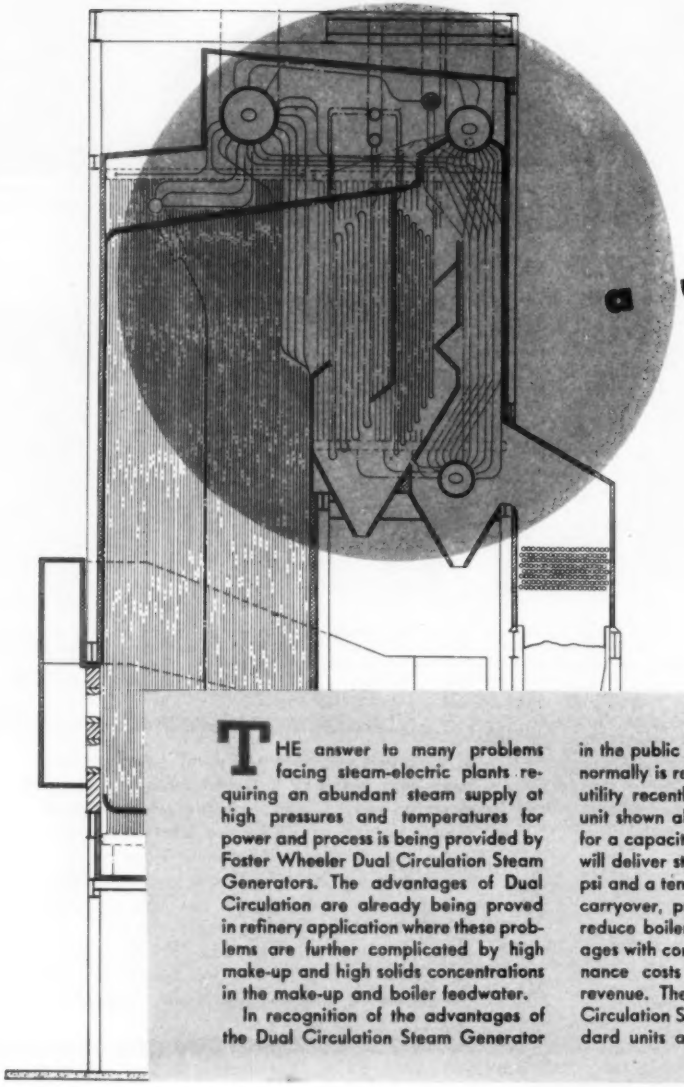
Application engineers, with many years of field experience, will tailor G-E synchronous motors and control to *your* job. And, no matter where you are located, there's a G-E Service Shop near you.

For your next large, synchronous motor application, call in your General Electric representative—he'll be glad to discuss with you, your particular application. For more information on G-E synchronous motors, write for GEA-5332 (low-speed) or GEA-5426 (High-speed) to: *Section 770-24, General Electric Company, Schenectady 5, New York.*

You can put your confidence in—

GENERAL ELECTRIC

770-24



a utility

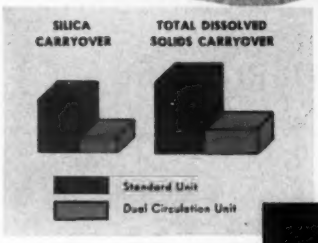
THE answer to many problems facing steam-electric plants requiring an abundant steam supply at high pressures and temperatures for power and process is being provided by Foster Wheeler Dual Circulation Steam Generators. The advantages of Dual Circulation are already being proved in refinery application where these problems are further complicated by high make-up and high solids concentrations in the make-up and boiler feedwater.

In recognition of the advantages of the Dual Circulation Steam Generator in the public utility field where make-up normally is relatively low, a midwestern utility recently ordered the three-drum unit shown above. This unit is designed for a capacity of 425,000 lb per hr and will deliver steam at a pressure of 1350 psi and a temperature of 955 F. The low carryover, previously unattainable, will reduce boiler and turbo-generator outages with consequent savings in maintenance costs and gains in operating revenue. The advantages of the Dual Circulation Steam Generator over standard units are illustrated at the right.

● *Write for a Copy of Bulletin B-50-11*

FOSTER WHEELER CORPORATION 165 BROADWAY NEW YORK 6.

specifies... DUAL-CIRCULATION

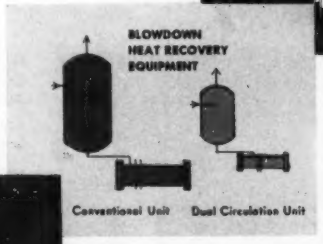


REDUCED CARRYOVER OF

a. Silica
b. Total Dissolved Solids

LOW CONCENTRATION IN HIGH DUTY FURNACE SECTION RESULTING IN

a. Minimum Tube Damage
b. Reduced Maintenance and Outage Time



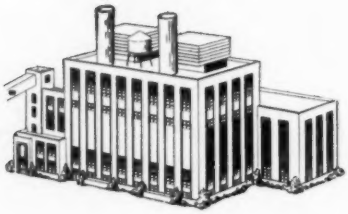
IMPORTANT SUPPLEMENTARY ADVANTAGES IN CERTAIN APPLICATIONS

a. Reduced Blowdown With Resulting Reduction In Heat Loss and Size of Heat Recovery Equipment

b. Reduced Cost of Chemicals and Equipment For Water Treatment

NEW YORK

FOSTER WHEELER

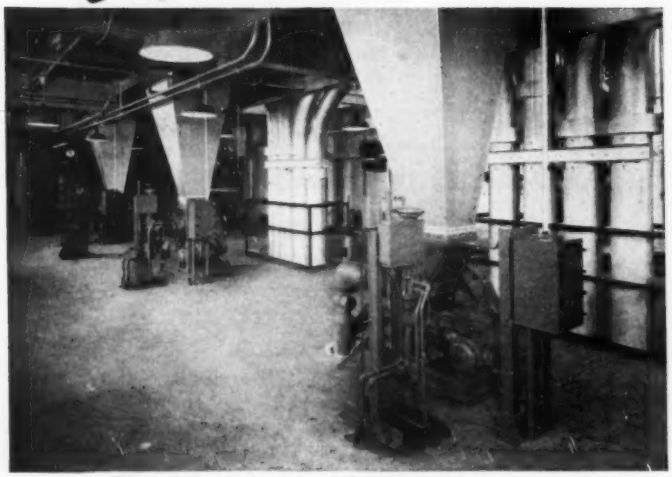


● at the New GADSDEN

Steam Plant of the

Alabama Power Company

Efficiency HAS BEEN



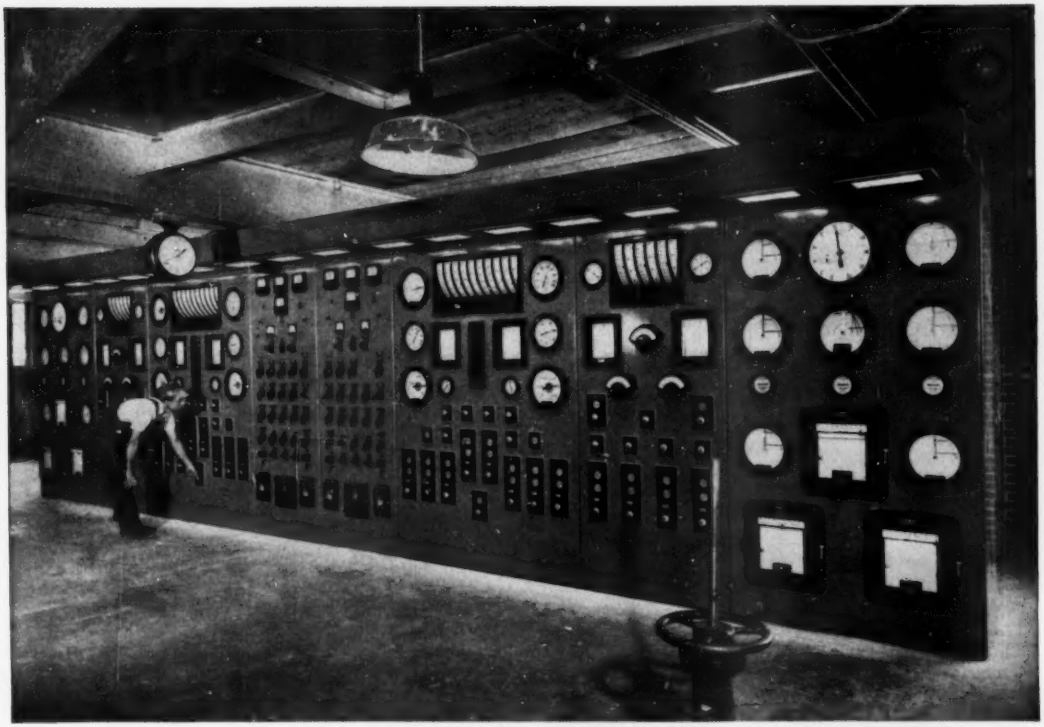
Three of the coal feeders and Republic regulators serving one of the boiler units.

It is the policy of Alabama Power Company to generate, transmit and distribute electricity to its customers at the lowest cost consistent with good service.

When designing the new 120,000 kw. Gadsden Steam Plant, the Alabama Power Company, in keeping with this policy, incorporated proven engineering developments which contribute to economical power generation. High among these was REPUBLIC automatic boiler control.

Two steam generators, each with a capacity of 600,000 pounds of steam per hour, and operated at 875 psig. and 885°F, supply steam to the two turbines. Fuels used are natural gas or pulverized coal, either singly, or in combinations.

The REPUBLIC control board is



On this Republic control board are mounted all gauges, meters and controls for operating each of the two boilers and their auxiliaries.

MADE *Automatic*

made up of one electrical panel, one recorder panel, and two combustion control panels per boiler. All panels are joined together to form one continuous board for the two boilers. The boilers are rubber mounted to reduce vibration, are gray in color, and lighted from an overhead canopy.

The REPUBLIC combustion control system receives its initial impulse from the main steam line through the master controller which establishes a pneumatic loading pressure proportional to the boiler load. The loading pressure is transmitted to the variable speed coal feeders, and to the gas flow valve when burning gas in combination with coal. This pressure is also transmitted to the air flow regulator. A corrector regulator provides means for maintaining the proper steam flow air flow relationship. Provision has also been made for manually adjusting this ratio from the boiler panel.

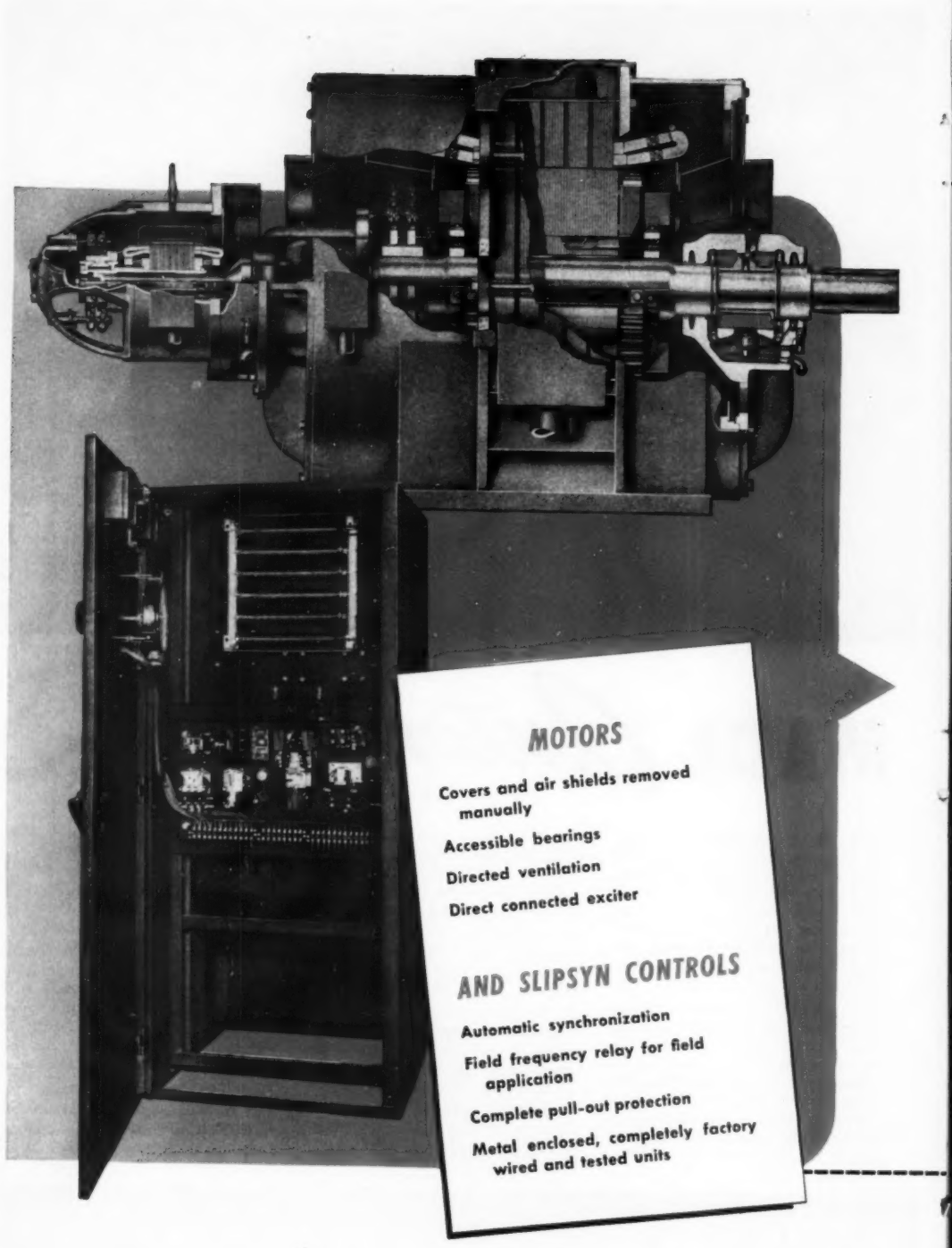
Air flow and furnace pressure are regulated by hydraulic coupling speed, but fan damper controls are provided for use at extremely low loads, when the fan speed would be reduced below 30% of the motor drive speed.

The boiler feedwater pumps are equipped with REPUBLIC automatic minimum flow hand reset valves. These valves open when the flow through the pumps is 150 gpm or less and by-pass this amount of water to the deaerating heater.

The REPUBLIC feedwater regulator is located on the operating floor and can be manually operated during emergencies from the boiler control panel. The valve control is pneumatic, single element, but the valve is operated by a hydraulic cylinder.

For complete information on REPUBLIC automatic boiler control write for Data Book No. S-21.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS



MOTORS

Covers and air shields removed manually

Accessible bearings

Directed ventilation

Direct connected exciter

AND SLIPSYN CONTROLS

Automatic synchronization

Field frequency relay for field application

Complete pull-out protection

Metal enclosed, completely factory wired and tested units

MORE POWER PER DOLLAR

with Westinghouse matched synchronous Motors and Controls

You can improve your power factor and save money on power bills with Westinghouse synchronous motors. You can save more by matching the control to the motor. That way you get a completely co-ordinated system that makes sure you get the full savings available.

HIGH MOTOR EFFICIENCY is inherent in synchronous motor design. Losses are lower than in induction motors. In many cases, the first cost is less. Considering first cost, low maintenance expense and improvement of power factor, the synchronous motor supplies more power per dollar for many types of drives than any other motor.

REDUCED MAINTENANCE COSTS are the result of exclusive inspection and servicing features. Readily accessible split-sleeve bearings can be removed by hand. There's no top half of bearing bracket to remove. Brushes are readily available through the front bracket for both inspection and maintenance.

CONTROL IMPROVES PERFORMANCE Getting the motor started right every time . . . providing complete protection at all times are the basic functions of the Slipsyn motor control. Heart of the system is the ASR polarized slip frequency relay. It not only applies the field at the proper speed, but also at favorable rotor position for best performance. Welded all-steel cabinets with sectionalized compartments protect personnel. All live parts are completely enclosed. Attractive cabinet blends with modern plant equipment.

MORE DATA? Get in touch with your local Westinghouse representative for complete details. Ask for copies of B-4379 "Slipsyn Control", and DB-3200. Or write direct to Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

J-10352

YOU CAN BE SURE.. IF IT'S

Westinghouse

LARGE SYNCHRONOUS MOTORS AND CONTROLS

KVS AIR SWEPT will pulverize at lower cost

All Grades of Coal Prepared for Combustion

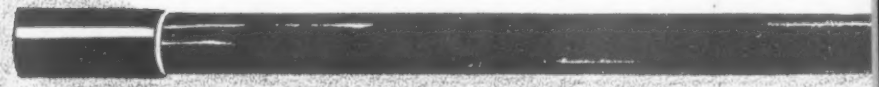
The KVS Air Swept Tube Mill . . . a slow speed ball mill . . . will handle bituminous coal, anthracite and coke breeze, preparing them for combustion at low operating and maintenance costs. Pulverizing is accomplished by Herculite steel balls thrown down in a continuous cascade, reducing the coal to superfineness. Air, fan-drawn through the mill, floats out an impalpable powder to the burners. The fuel, thus prepared, is completely carbureted, ready for combustion. Ability to prepare any solid fuel with KVS Air Swept Tube Mills means that there are no limitations placed on coal selection in plants where these mills are used.

Single Mill Capacities . . from 1,200 to 70,000 lbs. per hour

Regardless of capacity requirements, all of the following advantages are offered in KVS Air Swept Tube Mills:

- 85% of coal ground will pass through 200 mesh
- full capacity requirements instantly available
- instant response to controls
- high efficiency not affected by load changes
- unburnt carbon losses are less than one-half percent
- grinding balls added without shutting down mill
- 5% to 15% moisture evaporated in the mill
- availability, from actual experience, 99% and better

All other components of KVS Steam Generating Units are engineered to meet specific operating conditions on available fuels for high operating efficiency and maximum economy at all boiler ratings.

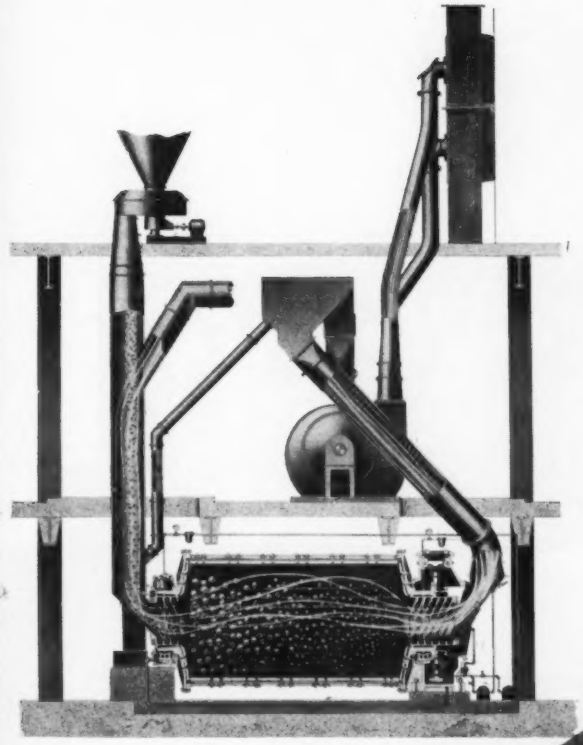


Send for a copy of Engineering Bulletin No. 44-B containing valuable information on the preparation of pulverized fuel and steam generation.

KVS ENGINEERING SERVICE

KVS is equipped to design and build complete power plants "from bunker to bus bar" in any part of the World and assume full responsibility for overall performance guarantees of all equipment, electrical as well as mechanical.

TUBE MILLS
YOUR coal...



Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA

AT ROCKFORD

CENTRAL ILLINOIS ELECTRIC AND GAS CO.
Rockford, Illinois

It's Detroit Rotograte

Detroit RotoGrate Stoker ready for shipment to Sabrooke Station.

FOUR CONTRACTS FOR TWO STATIONS

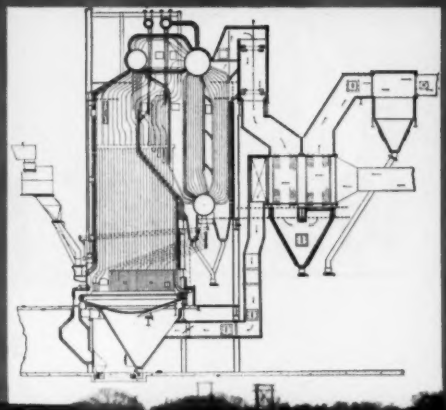
Stone & Webster Engineering Corporation
Engineers and Constructors

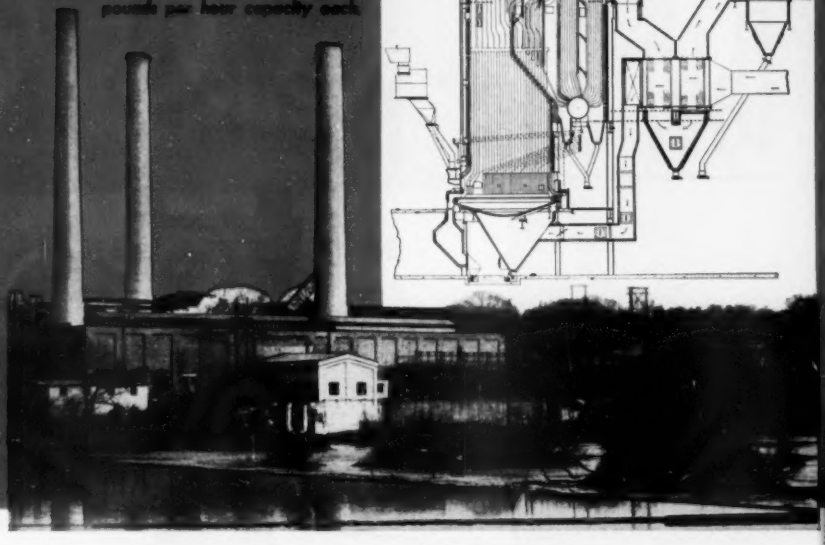
960,000 Pounds of Steam per Hour total Capacity

Write for complete information on Detroit RotoGrate Stokers.

EXTENDING FORDAM STATION

This side elevation of stoker and generator with economizer and air heater is typical of the Fordam and Sabrooke Station installations which have up to 300,000 pounds per hour capacity each.





Fordam Station Rockford, Illinois

Detroit RotoGrate Stokers were selected for the new boilers in the Fordam and Sabrooke Stations at Rockford:

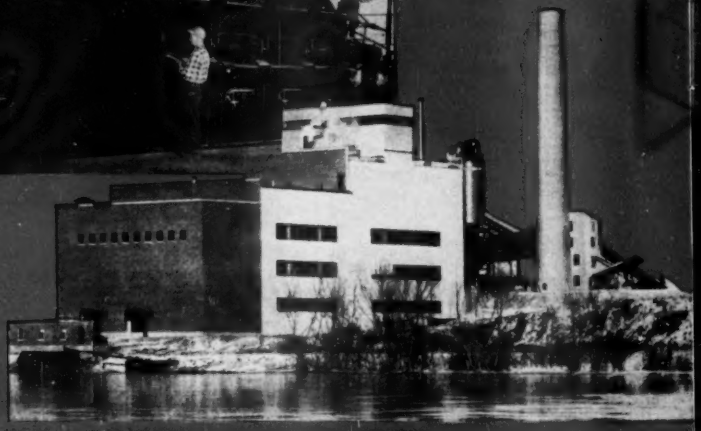
FIRST because they efficiently burn any type of bituminous coal. SECOND because of the lower investment necessary in equipment, foundations and building. THIRD because of lower power consumption to operate both stokers and auxiliaries and lower maintenance with a minimum of slagging difficulties in the furnace.

RotoGrate Stokers are modern spreader stokers with grates that move slowly forward, discharging the ash at the front. They permit high burning rates to produce more capacity per foot of furnace width.

At Rockford, as well as hundreds of other plants, they are operating at highest efficiency—with greatest satisfaction.

Interior of Sabrooke Station shows number one unit.

NEW SABROOKE STATION



Sabrooke Station— Rockford, Illinois

DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY

General Motors Building—Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Michigan

low-cost maintenance?

make it yours
with dependable quality

CRANE
VALVES

No. 960 Crane Brass Pressure Regulator for steam or air. Literature on request through your Crane Branch or Crane Wholesaler.

A CASE HISTORY FROM CRANE FILES

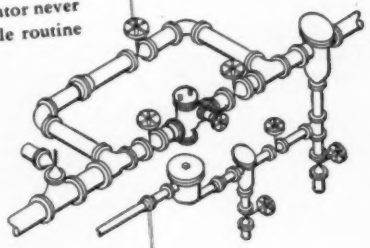
PROBLEM: To choose a pressure regulator that would assure a steady, unvarying steam supply to cooking kettle for an exacting brewing process.

WORKING CONDITIONS: Regulator subject to continuous operation 24 hours per day. Main steam supply at 100 psi to be constantly reduced and maintained at 30 psi.

SOLUTION: Crane No. 960 Brass Pressure Regulator. (*Former model with integral non-renewable cylinder.*)

RESULT: For 16 years, throughout its lifetime, the Crane 960 Regulator never failed, never faltered, never required more than prescribed simple routine servicing.

Replaced with new Model 960 Crane Pressure Regulator. With all wearing parts renewable, it will virtually never wear out. Now in service 18 months; operating cost: zero.

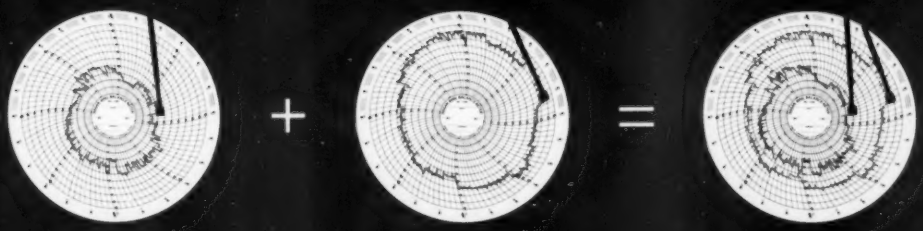


A typical example of the long life and low-cost maintenance that make Crane Quality the best value in all types of valves. That's why... More CRANE VALVES are used than any other make

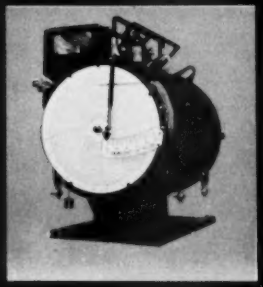
CRANE

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



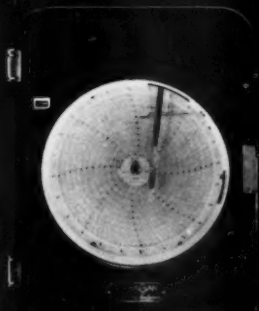
TWO METERS IN ONE CASE —the versatile HAGAN RING BALANCE DUAL METER



The standard case of the Hagan Ring Balance Dual Meter requires only the panel space of a single meter—but it contains *two* complete meters, which may operate independently or be linked together so that one modifies the record of the other.

Here are a few of the things this versatile meter will do:

1. Record two independent flows on a single chart, and totalize either or both. Either flow record may be compensated automatically for temperature and/or pressure.
2. Automatically add or subtract two recorded flow measurements, recording and totalizing the sum or difference.
3. Record a flow which is corrected for density or gravity. In this application the measurement made by one ring acts as a corrector for the measurement made by the second ring. A record of liquid level corrected for density may be obtained in the same way.



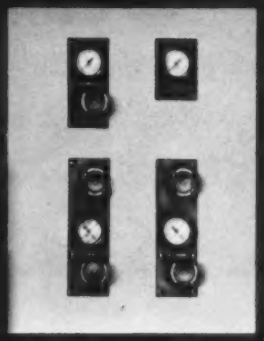
Standard ring assemblies may be used in any combination. These are available for measuring maximum differentials from ½" to 420" water column, at static pressures up to 10,000 psig.

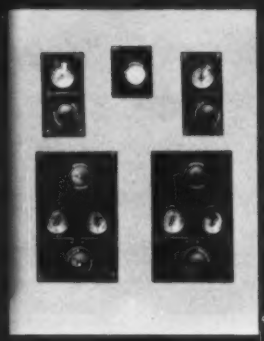
We will be glad to furnish full information concerning these or other Hagan Ring Balance Meters.

HAGAN CORPORATION
HAGAN BUILDING, PITTSBURGH 30, PA.

combustion control systems . . . ring balance flow and pressure instruments

FLEXIBLE
PANEL ARRANGEMENT





WITH

HAGAN

PNEUMATIC RELAY STATIONS

Economical use of panel space is a most important consideration.

Each element of any Hagan Pneumatic Relay Station is designed for mounting as an individual unit directly on the panel, or in any combination with other elements on a small sub-panel.

Standard relay elements are designed for remote manual positioning, remote set point adjustment, remote selection of manual or automatic control, remote adjustment for biasing operation of two or more units, remote adjustment of the ratio of fuel and air or of several fuels.

The wide choice of panel arrangement keeps space requirements to a minimum. The variety of relay types is assurance of maximum flexibility and convenience of operation—features which are typical of the *extra values* built into Hagan Automatic Control Systems.

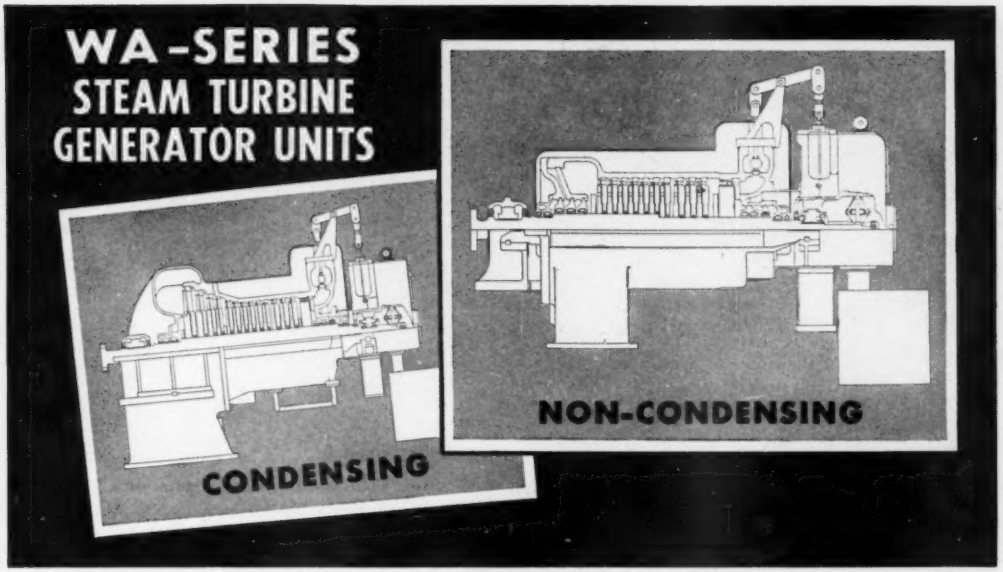
HAGAN

HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PA.

RING BALANCE HAGAN Ring Balance

combustion control systems . . . ring balance flow and pressure instruments



Expanding? The WA-Series will Fit into Your Plant

TODAY INDUSTRY MUST EXPAND while producing at a record rate. To help this vital expansion, Allis-Chalmers offers modern WA-Series steam turbine generator units for industrial and utility steam power plants.

If you prefer high quality construction and modern design, be sure to investigate the recently announced WA-Series, now being built in ratings through 7500 kw. The most recent developments are embodied in this modern impulse design, built for both condensing and non-condensing service, with or without automatic extraction.

Built in NEMA ratings, the WA-Series steam turbine generators are compact, three-bearing, solidly coupled units. They are being built in the condensing type, for power generation only, and in the non-condensing and automatic extraction types, to tie in thermodynamically and provide a steam-power balance where process steam is used.

Design and construction of WA-Series units meet the rigid standards Allis-Chalmers has established for its entire steam turbine line. Just as in the larger steam turbines ranging to 150,000 kw, labyrinth steam seals are used for shaft glands and interstage packing. Corrosion and erosion resistant high chrome alloy steel buckets and nozzles are used throughout in the WA-Series.

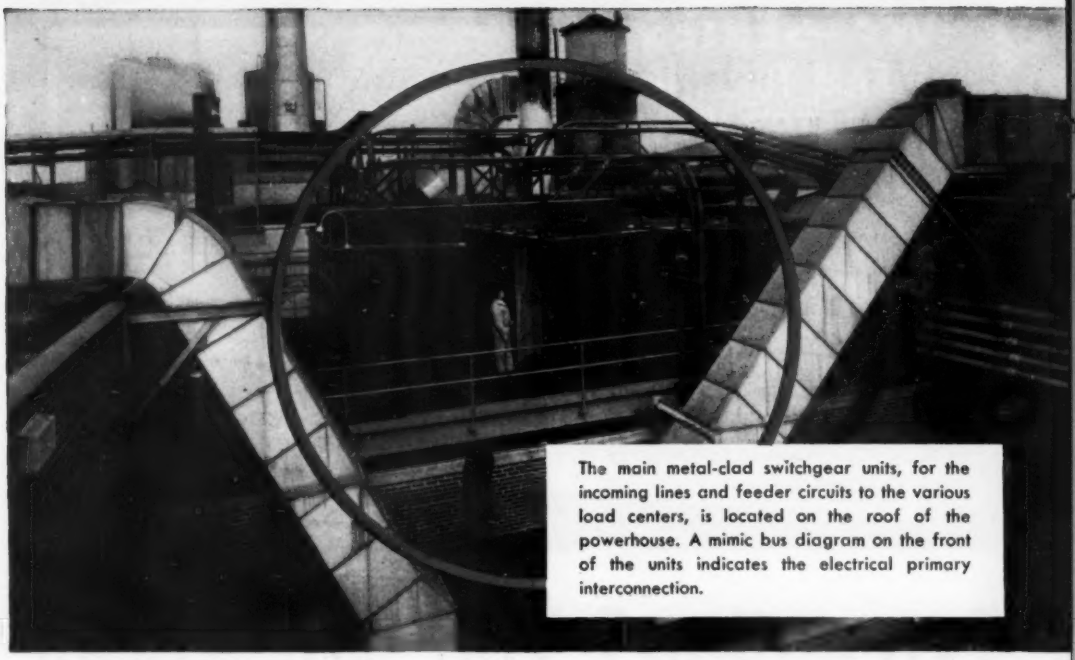
WA-Series units are completely coordinated in design. Impulse turbine, housing type air-cooled generator, and exciter are all especially engineered to operate as a unit. *And*, the entire unit is manufactured, assembled, and tested under one supervision at one plant.

Make sure that your next generating unit is *quality* built and has *all* the latest features. Call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3312

ALLIS-CHALMERS

TURBINES & GENERATORS | CONDENSERS & PUMPS | SWITCHGEAR & BREAKERS | MOTORS & CONTROL | TRANSFORMERS | WATER CONDITIONING

World's Widest Range of Power Plant Equipment



The main metal-clad switchgear units, for the incoming lines and feeder circuits to the various load centers, is located on the roof of the powerhouse. A mimic bus diagram on the front of the units indicates the electrical primary interconnection.

PUTS SWITCHGEAR ON ROOF

saves 10,000 sq. ft. of floor space

Indoor space limited—installation made with almost no interruption of production —Maintenance will be greatly simplified.

When Scott Paper Company, of Chester, Penna., completely revamped its electrical system to take care of expanded plant output, it made one rather unusual decision. Because indoor space was limited, it put all its switchgear and load-center units on the roofs of the various buildings. The incoming utility power lines, at 13,200 volts, terminate in General Electric outdoor metal-clad switchgear on the roof of the powerhouse, and the 575-volt distribution system is fed through G-E metal-enclosed gear located on roofs of the individual buildings. Distribution between buildings is at 13,200 volts with step-down load-center units.

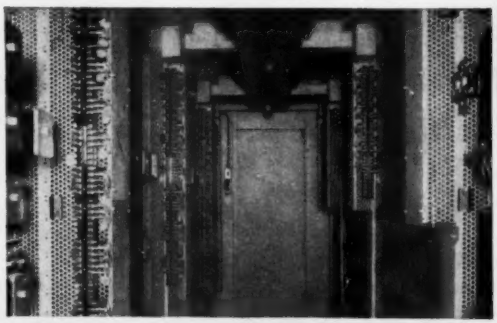
This type of installation has proved to have a number of advantages. In the case of Scott Paper, 10,000 square feet of badly needed floor space became available for paper making. The entire installation could be made during normal working hours, yet did not interfere with plant production. Likewise, routine inspection and maintenance can be done without entering the manufacturing areas. All breakers are of the easily-removable type that is so easy to maintain and inspect.

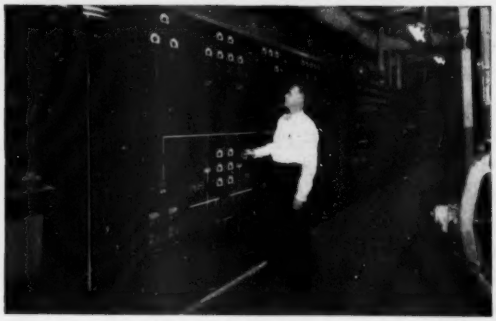
What's more, there's plenty of space for expansion. Provision has been made to double the capacity—by adding transformers and switchgear—when still more electric power is needed later. ***Apparatus Department, General Electric Company, Schenectady 5, N. Y.***

A double ended load-center unit feeding the large 2300-volt motors in one of the main buildings. Unit consists of two power transformers with air-interrupter disconnects, and metal-clad switchgear units for metering and for the four magne-blast air circuit breakers.

One of several single-ended load centers, which can be doubled in capacity later by adding a second transformer and low-voltage switchgear units. This particular unit uses metal-enclosed gear with draw-out air breakers to 575-volt feeders which serve the paper finishing units.

New switchboards simplify control — Increase safety



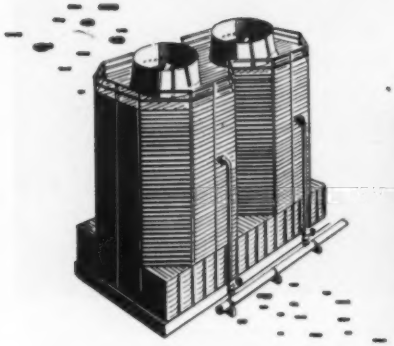


BEFORE Front and rear views of the old switchboard which handled all the plant's power at 575 volts. Open buses, breakers, knife-switches, and resistors were a definite hazard — and one bad short circuit or fire could have closed down the plant.

AFTER Main switchboard is now simply a control board. Incoming line and feeder circuits can all be closed from this one location. No power lines or high voltage is brought to this board at all—and there are no open buses or switches to form a hazard to personnel.

854-33

GENERAL ELECTRIC



FLUOR COUNTERFLO COOLING TOWERS offer many unique features — all worth looking into!

When selecting cooling towers, it pays to look into the structural and mechanical design features of a Fluor Counterflo Cooling Tower. It is here that the difference between one cooling tower and another is evident—where the difference in structural stability, maintenance of mechanical equipment, and quality appearance lies.

The illustration at right—accurate in every detail—is the way your Fluor Counterflo Cooling Tower will look with a portion of the exterior wall removed. Note the exclusives, the extras, that make Fluor Cooling Towers a wise buy. When *dependable* performance, *low* maintenance, and *quality* appearance is essential or desirable in your plant or process operations, look into a Fluor Counterflo Cooling Tower.

STACK and FAN ASSEMBLY

5' high fan stacks of 2" thick tongue-and-grooved redwood staves, rigidly staged with steel angles and straps. Fan shaft is supported on heavy, ball-mounted metal ring—Drive shaft, couplings, right-angle reduction gear and stainless steel fan blades assure long life and low maintenance—Patented Vibration Cut-Out Switch guarantees safety.

Fluor Counterflo Induced-Draft Cooling Towers incorporate many important design features which cut the cost of maintenance and improve the appearance of cooling equipment installations.

DRIFT ELIMINATORS

Fluor Drift Eliminators are designed for minimum resistance to air flow induced through the tower. Two-pass, zig-zag pattern removes entrained water droplets from the air stream and controls drift loss to less than 0.2 of 1 per cent of water circulated.

DISTRIBUTING SYSTEM

Uppercy circulation flushes an appreciable portion of heat load as water enters the tower. Patented, non-clogging, self-draining Spiradome nozzles insure water break-up under nominal pressure. Nozzle spacing controls uniform water distribution. Cell distributing systems are independent to assure maximum control efficiency of water being cooled.

DOUBLE-WALL SHEATHING

Panels of sheathing are positioned in uniform areas to enable heat, warm circulation. Inner wall is of 1" tongue-and-groove redwood—outer wall is of 3/8" softwood, spaced 1-1/16" apart—2" opening between walls permits air circulation and prevents dry rot.

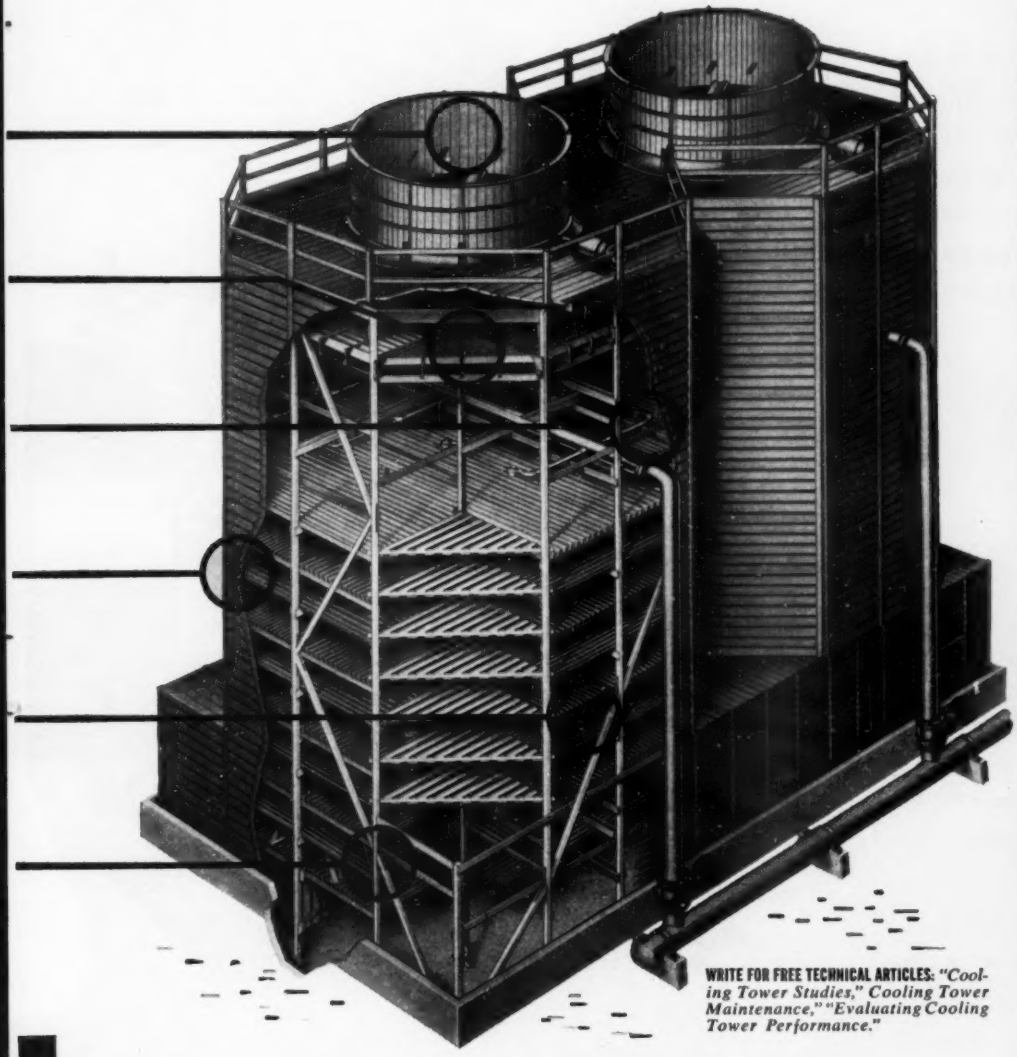
GRID DECKS

Stepped staging-bar grid decks are of rough-finished 1" thick select redwood—will withstand repeated washing and cleaning and are sufficiently strong to support a man's weight at the above of removing and replacing. Prefabrication and structural strength permit use of grid decks as scaffolding during erection.

TOWER STRUCTURE

Stepped 4" x 4" posts with 4" x 4" and 2" x 4" bracing—Corrosion-proof bolted internal gusset plate structural joints take both tension and compression for extra safety under all conditions. Posts are on 6' centers. Columns and bracing are designed with forethought to future tower extension—panels are reusable on new extension—bracing and columns need no modification.

BE SURE WITH **FLUOR**



WRITE FOR FREE TECHNICAL ARTICLES: *"Cooling Tower Studies," Cooling Tower Maintenance," "Evaluating Cooling Tower Performance."*

THE FLUOR CORPORATION, LTD., 2500 South Atlantic Boulevard, Los Angeles 22, California

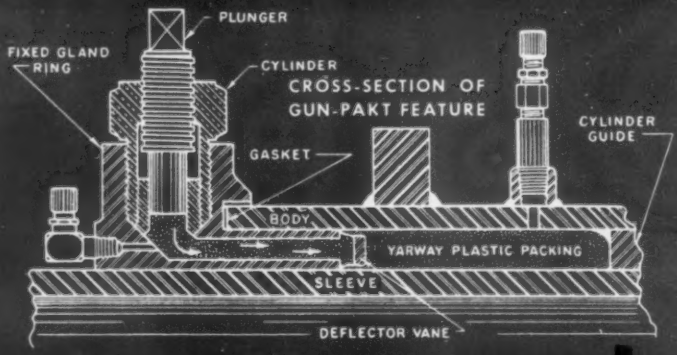
New York, Chicago, Boston, Pittsburgh, Tulsa, Houston, San Francisco, Birmingham, Calgary.

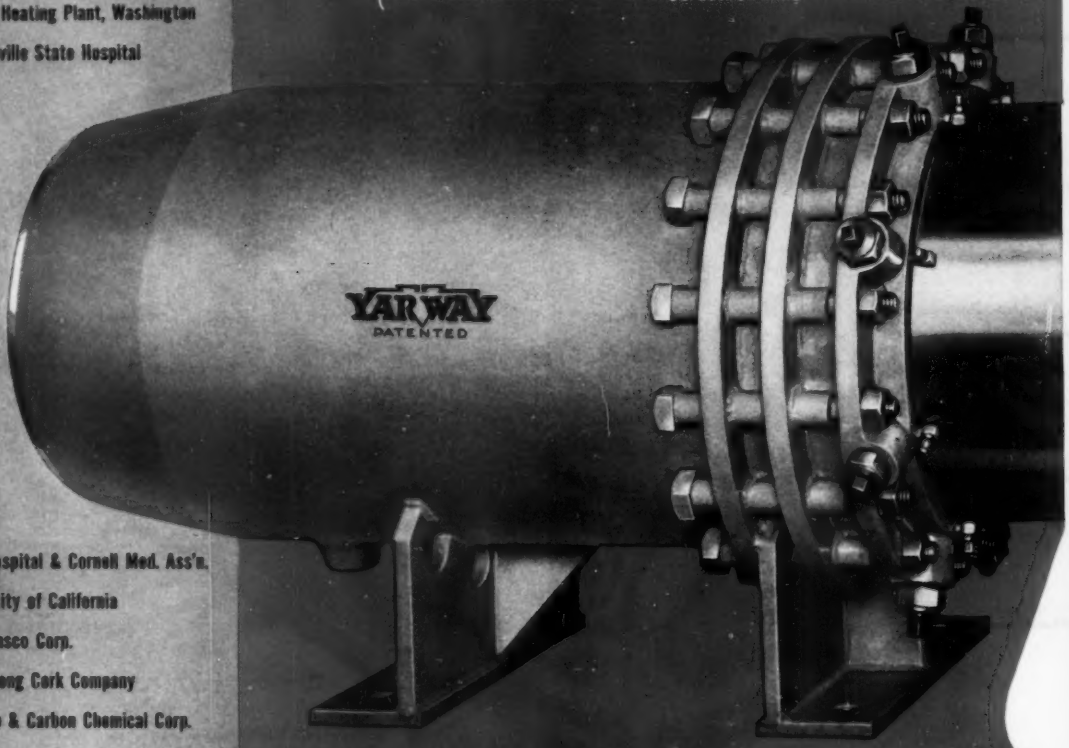
REPRESENTED IN THE STERLING AREAS BY: Head Wrightson Processes Ltd., Teesdale House, Faltic Street, London, E.C.I., England

TYPICAL USERS

Allegheny Co. Steam Heating Company
Sanitary District of Chicago
City of Cleveland
Florida Power & Light Company
Georgia Power Company
Philadelphia Electric Company
Dayton Power & Light Company
Camarillo (Cal.) State Hospital
Central Heating Plant, Washington
Jacksonville State Hospital

this expansion joint





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YARWAY

offers...

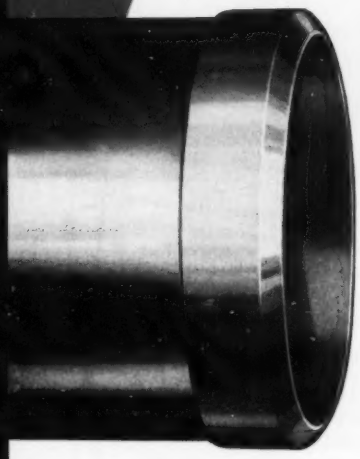
FREEDOM FROM SHUTDOWNS

What feature do you want most in an expansion joint . . . sure movement, simplified installation, ease of servicing, low cost, low upkeep?

Yes, they're all important. But when you're dealing with steam under pressure, *there's nothing more important than reliability—freedom from shutdowns.*

The high factor of safety in Yarway Gun-Pakt Expansion Joints prevents shutdown losses—eliminates accident hazards.

Gun-Pakt Joints are *rugged* joints, strong and dependable. They are *serviced under full steam pressure.* Packing is added simply by inserting a plug of Yarway plastic packing and turning a wrench . . . the joint's tight, the job done.



Yarway Single-end Gun-Pakt Expansion Joint, welding type. Double-end and flanged types also available.

FEWER JOINTS NEEDED

With Yarway Gun-Pakt Joints you need fewer joints per length of pipe line. Each sliding sleeve may have a traverse of either 4", 8" or 12" . . . maximum expansion being 24" for a double-end joint.

Gun-Pakt is more than just another expansion joint—it is a revolutionary idea in expansion joint engineering. Its success is shown by wide use in leading central heating stations, institutions and industrial plants.

Get the full Gun-Pakt story . . . get Yarway Bulletin SJ-1912. Write to . . .

YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Pa.

Branch Offices in all Principal Cities

GUN-PAKT EXPANSION JOINT

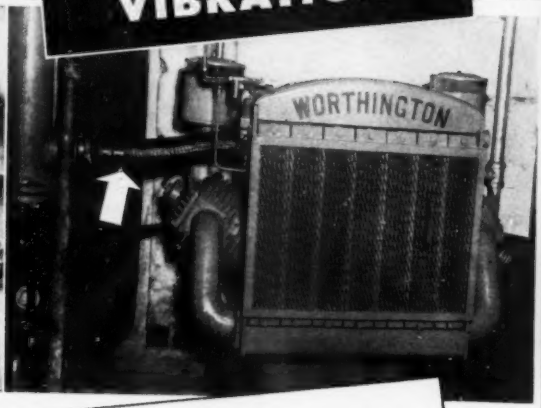
Here's how CMH FLEXIBLE

solves the basic motion

MISALIGNMENT

● For the dewaxing filter connections illustrated, CMH corrugated flexible metal hose solves the misalignment problem and compensates for expansion and contraction as well. The use of CMH Flexible Metal Hose for making connections between misaligned sections of piping frequently saves time and money . . . it eliminates the need for complicated piping and an excessive number of fittings . . . it also simplifies and speeds up assembly and disassembly of the piping.

VIBRATION

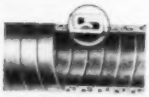


● Vibration in the air compressor shown above was isolated by means of inserting short lengths of CMH flexible metal hose into the connecting lines. In all installations which incorporate vibrating components such as compressors, turbines, engines, etc., CMH flexible metal hose used as the connecting link to fixed piping effectively isolates the damaging effects of vibration and minimizes objectionable noise.

CMH
ONE DEPENDABLE SOURCE for every flexible metal hose requirement

® **FLEXON** identifies CMH products that have served industry for over 49 years.

Metal Conduits in a variety of types and materials.

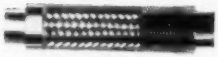


Convoluted Metal Hose in a variety of types—steel bronze and alloys.

Corrugated Metal Hose in steel, bronze stainless steel and other alloys.

Expansion Joints for all pressures—copper, stainless steel and other alloys.

Bellows for all requirements —brass, stainless steel and other alloys.



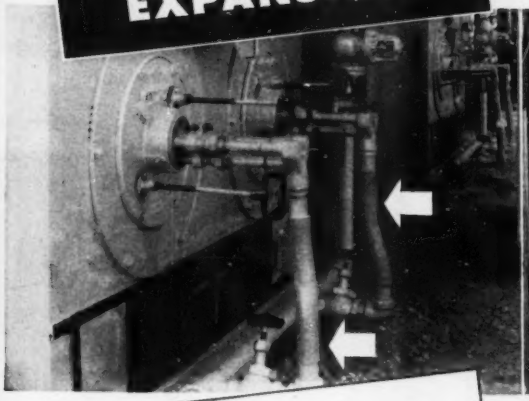
Standard Assemblies of metal hose components for specialized applications.

Leaders in the Science of Flexonics

METAL HOSE

problems of conducting liquids, gases and solids

EXPANSION



● The gas connections in this boiler are subjected to expansion and contraction as the unit is brought up to operating temperature. Short lengths of CMH flexible metal hose solve this problem and eliminate the misalignment problem, too. Use CMH flexible metal hose or expansion joints in all services that include piping which is subject to expansion and contraction.

FLEXATION

● The steam connections for this rubber molding platen press are typical of how CMH flexible metal hose is used for moving connections on everything from rugged tire vulcanizers to delicate weigh tanks. When connections between moving sections are made with CMH flexible metal hose, the lines are able to offer maximum resistance to external damage and at the same time withstand high temperatures, high pressures and frequent, repeated motion for long periods.

IN CMH's complete line of flexible metal hose products there is the exact type to meet your needs. Pressures from vacuum to 12,000 psi (burst) and temperatures from far below 0° to 1600° F. can be accommodated by the various types. CMH flexible metal hose is manufactured in a wide variety of metals including types which are corrosion resistant, fire resistant and able to hold extremely searching liquids and gases.

Whatever your connection problem, if there is misalignment, vibration, expansion or flexation, CMH offers the economical, dependable, safe solution. If you do not already have literature describing the CMH line of flexible metal hose products, write for it today mentioning the types of connection problems you have.

CHICAGO METAL HOSE CORPORATION

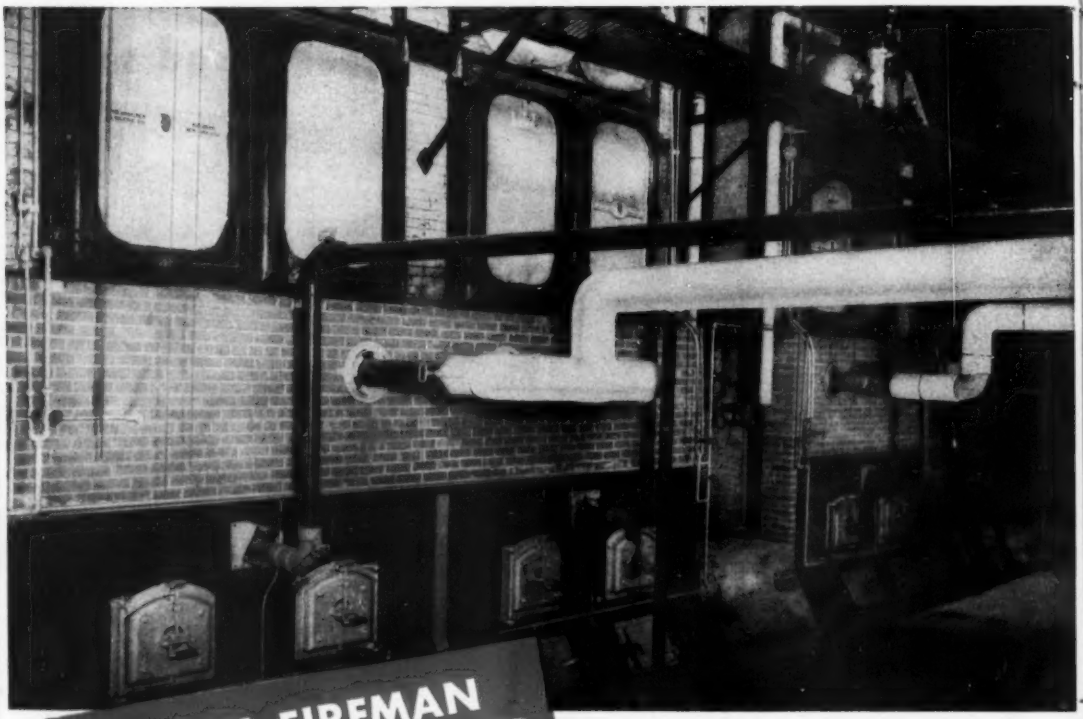
1301 S. Third Avenue — Maywood, Illinois

Distributors in principal cities—see your classified telephone directory

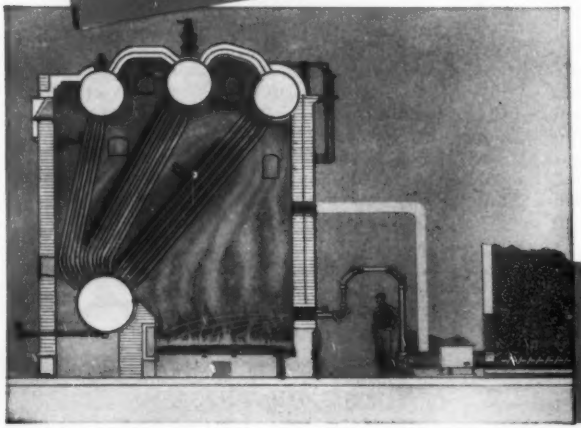
In Canada: Canadian Metal Hose Co., Ltd., Brampton, Ontario

Plants at Maywood, Elgin and Rock Falls, Illinois

Coal handling and coal firing . . .



IRON FIREMAN PNEUMATIC SPREADER STOKER



CONVEYS DRY COAL ON STREAM OF PRE-HEATED AIR

Coal is thoroughly dried and pre-heated before it is conveyed pneumatically to furnace grates. Dry coal assures far more uniform distribution. The distributor nozzle spreads the dry coal over the *entire* grate in a shallow, uniform fuel bed and not simply on the front of the grate as is usually the case with wet coal. Preheated fines burn in suspension, reducing cinder carry-over and greatly improving combustion efficiency and responsiveness as compared with stokers which do not pre-heat coal.

IRON

. combined IN ONE UNIT

HANDLES COAL AUTOMATICALLY
Cuts labor and equipment costs

DRIES AND PRE-HEATS COAL
Assures uniform fuel distribution

BURNS ECONOMY COALS
Reduces fuel costs

Burns all grades and types of **BITUMINOUS COAL** from ¼" slack to 2" top size

The Iron Fireman Pneumatic Spreader stoker is more than just a stoker. It is a complete COAL HANDLING AND COMBUSTION SYSTEM. No other stoker combines its many exclusive features and money saving "extras."

Manual coal handling or expensive handling equipment are completely eliminated—and without extra cost. Coal is conveyed pneumatically, direct from bunker or bin to the furnace grates.

The Iron Fireman Pneumatic Spreader stoker burns all grades and sizes of bituminous coals, including low ash fusion, sub-bituminous and lignite—ranging from ¼" slack to 2" top size. In addition, it is ideally adapted to burning the better quality grades of bituminous coal.

Coal is thoroughly dried and pre-heated before it is conveyed to the furnace and distributed over the grates. This assures far more uniform distribution over the *entire* grate.

Fuel feed and air volume rate are automatically synchronized. Air supply is kept in step with coal feed-rate at all times. The exclusive Iron Fireman infinitely variable transmission, combined with the Iron Fireman Volumeter, assures maximum efficiency at all rates of operation.

You save in other ways, too. The Iron Fireman Pneumatic Spreader stoker is readily adaptable to any boiler room layout—and without costly alterations. Coal bunkers or bins can be located in almost any position relative to the boilers—even on another level above or below the firing floor. Maintenance costs are low. All moving parts are located away from the direct heat of the combustion chamber. Easy to inspect and service. Capacities available to 1,000 boiler horsepower in single units. Multiple units for larger capacities.

Find out today how Iron Fireman firing will cut fuel and labor costs in your boiler room. A survey in your plant, made without cost or obligation to you, will show you. For such a survey, or descriptive literature, write Iron Fireman Mfg. Co., 3131 W. 106th St., Cleveland 11, Ohio, or call your nearest Iron Fireman dealer.

FIREMAN COAL, GAS, OIL FIRING FOR POWER, HEATING OR PROCESSING

WESTINGHOUSE
Life-Linestarter
DO NOT LUBRICATE
Life-Linestarter
PAIRED FOR PRODUCTION
Life-Line motor

STOP costly down time with this pair

"Down-time minutes" can mean a loss of hundreds of units or thousands of dollars. Here's a production team—the best defense against down time—Life-Line motors and Life-Linestarters®. They're paired for production.

Advanced design of these two have eliminated common troubles. Look at the features that make it possible:

Life-Line motor

Steel frame... adds strength, cuts weight.

Pre-lubricated bearings... no greasing.

Improved windings... protected by tough Thermoset varnish, add electrical life.

Life-Linestarter

Bimetallic disc... calibration unaffected by aging or oxidation.

Servicing is simple... all parts removable.

Screw driver only tool required.

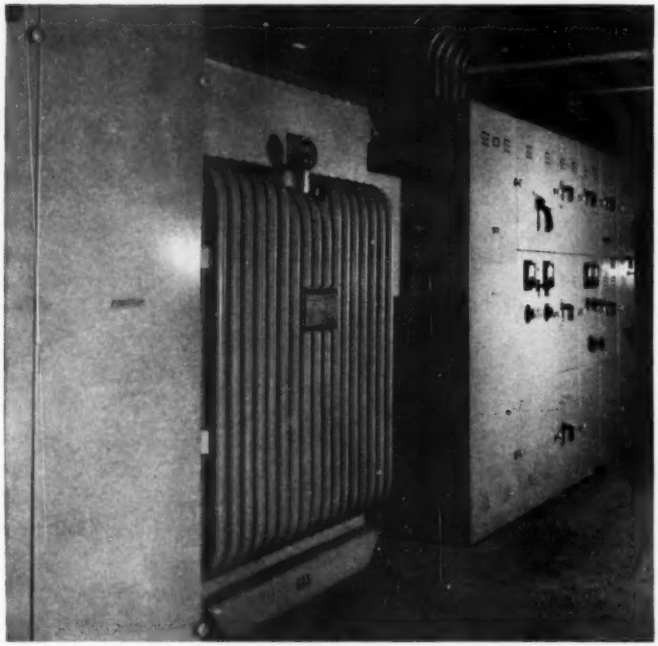
Get these two dependable performers—paired for production—and stop costly down time. For complete information, ask your Westinghouse representative for "Life-Line Motor Book", B-3842 and "Tomorrow's Starter Today", B-4677, or write direct to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21639

YOU CAN BE SURE... IF IT'S Westinghouse

Life-Line

MOTORS and CONTROLS

Milwaukee Plant gets D.C. Power
AT $5,000 ANNUAL SAVING



IGNITRON RECTIFIER

This photograph shows the simple, compact design of the G-E Ignitron Rectifier. No major moving parts to wear out or require attention. No vacuum pump is required. Result is the lowest possible operating cost for producing d-c power.

More than two years of trouble-free 24-hour-a-day operation have proved the advantages of the G-E Ignitron Rectifier installed at the Milwaukee Lace Paper Company.

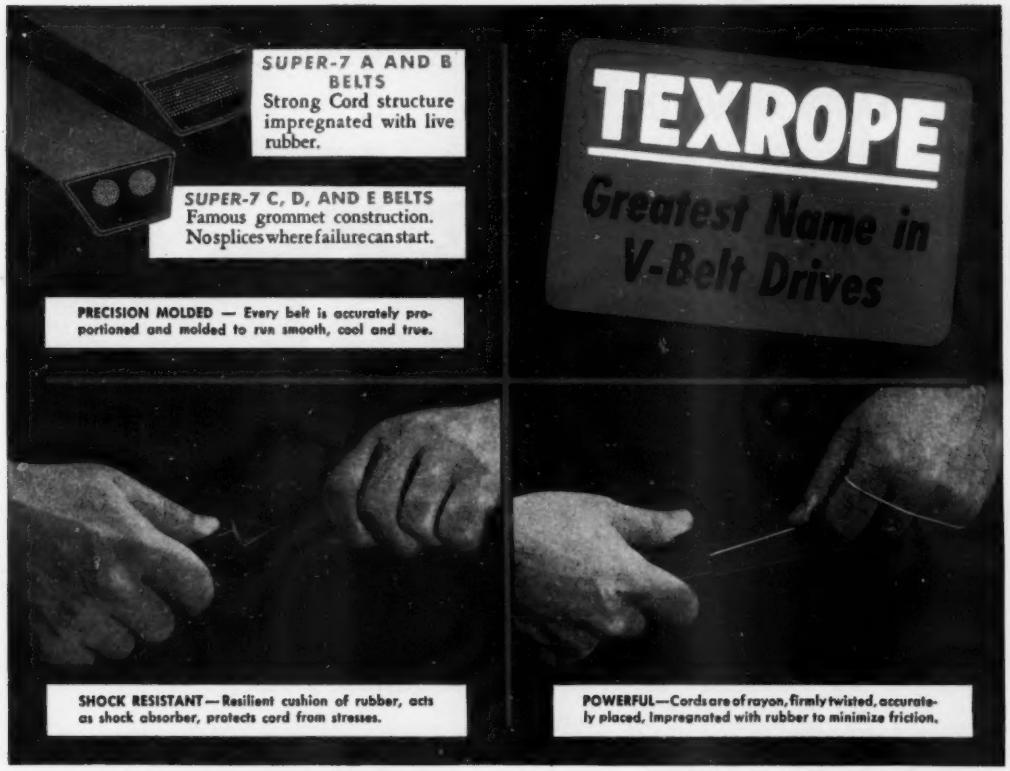
Compared with the old steam-driven generators previously used, the G-E Ignitron Rectifier shows a saving in operating cost of $5,000 annually. Stationary engineers are no longer necessary in the company's production of d-c power, can now attend to other plant operations. The G-E Ignitron Rectifier operates 24 hours a day, 7 days a week, with minimum attention. In addition, it gives a steadier, constant voltage over the entire load range, and higher short-time overload capacity.

Supplied as a complete packaged unit with transformer and metal-enclosed switchgear, the installation occupies minimum space.

Call or write your nearest G-E sales office for information on a G-E Ignitron Rectifier to fit your d-c power needs. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

324-1

GENERAL ELECTRIC


SUPER-7 A AND B BELTS
Strong Cord structure impregnated with live rubber.
SUPER-7 C, D, AND E BELTS
Famous grommet construction. No splices where failure can start.
PRECISION MOLDED — Every belt is accurately proportioned and molded to run smooth, cool and true.
TEXROPE
Greatest Name in V-Belt Drives
SHOCK RESISTANT — Resilient cushion of rubber, acts as shock absorber, protects cord from stresses.
POWERFUL — Cords are of rayon, firmly twisted, accurately placed, impregnated with rubber to minimize friction.

Cool Running...LONG LIVED!

SUPER-7 V-belts give long, satisfactory service even under bad conditions of load, shock and grit.

Tough, double-wrapped cover bias cut for elasticity and impregnated with rubber. Effectively seals out dust, grit, moisture; takes the wear; keeps the belt in shape; and protects cord structure.

But you get more than good belts when you standardize on *Super-7* V-belts. You also get the benefit of the greatest V-belt experience in the world both in the field and factory. You are assured of exactly the right drive for longest life from the wide variety of types and sizes available.

High Capacity Belts

Where space is limited or other special conditions demand heavier duty, the high capacity belt can be furnished in A, B, C, D, and E sections . . . Extra strong cords, special rubber cushion and tough Neoprene cover give them 40% greater capacity than standard belts at proportionately higher price.

V-Belt Drive Headquarters

Your nearby Allis-Chalmers Authorized Dealer or Sales Office can serve all your V-belt needs, whether they be new or replacement V-belts; standard and variable speed sheaves; or speed changers.

Get your copy of the revised 120 page *Texrope* Pre-Engineered Drive Manual from your A-C Dealer or Sales Office or write for Booklet 20B6956A. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3291

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

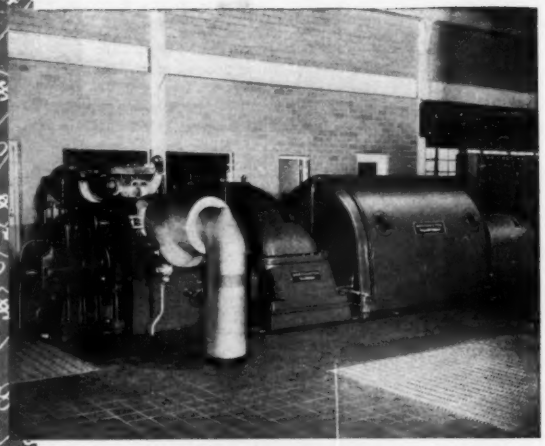
CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

Texrope and Super-7 are Allis-Chalmers trademarks.

ALLIS-CHALMERS

FACTS ABOUT THE *Most Profitable Turbine Generator Investment* YOU CAN MAKE...



One of two Worthington 4000 kw turbine generator sets installed in a mid-western municipal power plant, operating on 600 #G and 750 F.T.T. Steam exhausting to 28" Hg vacuum.

Worthington's Experience and Undivided Responsibility Assure Low Cost, Dependable Power

Builders of steam turbines for over 30 years, Worthington's Steam Turbine Division is backed by the experience and resources of the entire Worthington organization — recognized leaders in the power plant field for more than a century. In view of today's increased turbine pressures and temperatures — and the resulting needs for new and special materials — this vast, combined source of technical knowledge has proved of tremendous practical value in developing turbine design, construction and performance.

Generators Are Worthington's, Too

The generators used with Worthington Turbines are built by a Worthington subsidiary that has specialized in this field for over 45 years. This means that Worthington, as manufacturers of *complete* turbine generator units, assumes *undivided responsibility* for the coordinated design, assembly and performance of these units.

Before shipment, Worthington Turbines and Generators are assembled together *as units* for testing and adjustment — eliminating the necessity for doing this after installation. Also, for installation and service, Worthington turbine specialists and regular Worthington service men are always available from our District Offices throughout the country.

Check These Over!

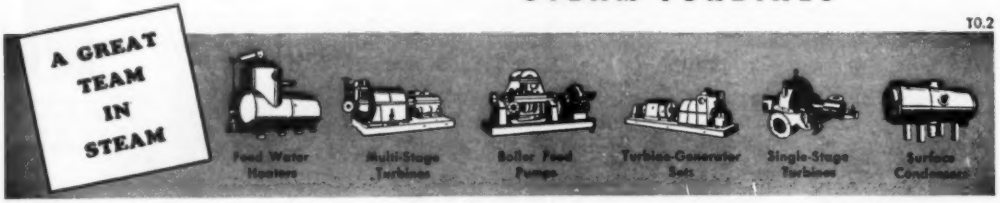
Adding up, Worthington's matchless power plant experience . . . huge manufacturing facilities . . . long specialization in both turbine and generator manufacture . . . undivided unit responsibility . . . and skilled technical service . . . are the best assurance you can get anywhere of efficient, economical steam turbine power.

Worthington makes turbines in a wide range of sizes and types, each one designed to make steam do more work. For details proving *there's more worth in Worthington*, contact your nearest Worthington representative. Or write to *Worthington Pump and Machinery Corp., Steam Turbine Division, Wellsville, N. Y.*

WORTHINGTON

STEAM TURBINES

T0.2



Remember—

the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Bring on your severe conditions—

YOUR FIRST CHOICE for *severe service* conditions in piping is the TUBE-TURN Welding Neck Flange. It is engineered with a long tapered hub and a smooth transition in thickness to the pipe-end bevel. This means greater pressure-containing capacity under extreme temperature as well as much longer life than other types when repeated pipe bending or severe vibrations are involved.

For other jobs choose from these TUBE-TURN Welding Flanges: slip-on flanges; lap-joint flanges; socket-welding flanges; blind flanges; orifice flanges; pipeline non-standard flanges. Get in touch with your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

Write Dept. C-3 for free booklet, "Research on the Cyclic Life of Piping Systems."

"Be sure you see the double tt"

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles

TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO . . . A wholly owned subsidiary of TUBE TURNS, INC.

Welded wrought-iron lines serve new Hospital Buildings

Underground tunnels at Cleveland's City Hospital contain the old and the new in piping. New 125-pound steam main (Fig. 1) serving several new buildings is welded. A welded system with TUBE-TURN Fittings was chosen to cut installation time, and to get tight, leakproof joints.

New welded line (Fig. 2) elbows neatly over an older pipe. When space is confined like this, welding is the answer. Contractor welded pipe from 2" up to 12" in tunnels, boiler room and power house.

With welding equipment on the job it's easier to put up pipe supports too. Eyebolt (Fig. 3) is quickly welded to TUBE-TURN Elbow, support rod hooked through it. This steam line to the water heaters must be secure.

Insulation on the maze of piping to the boiler feed pumps (Fig. 4) went up fast, with no flanges to work around. In such close quarters a neat design and reduced space requirements are especially important. And with the pipe welded to TUBE-TURN Fittings, joints won't leak, and insulation will last.

DISTRICT OFFICES
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Pittsburgh
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TUBE TURNS, INC.
LOUISVILLE, KENTUCKY

TUBE TURNS, INC., Dept. C-3
224 East Broadway • Louisville 1, Kentucky

Your Name .....
Position .....
Company .....
Nature of Business .....
Address .....
City ..... *State* .....

Fig. 1. Welded underground steam main.

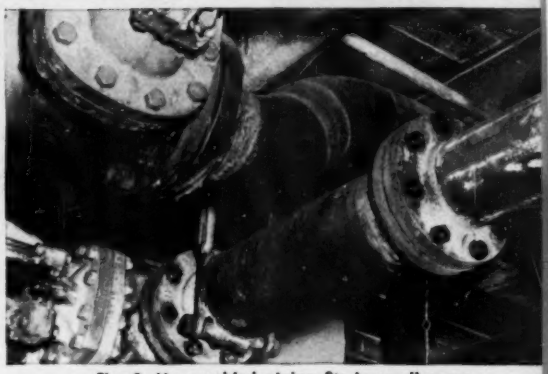


Fig. 2. New welded piping fits in small space.

Fig. 3. Support on steam line elbow.

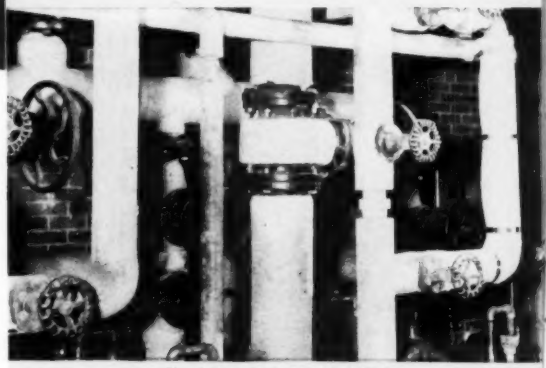
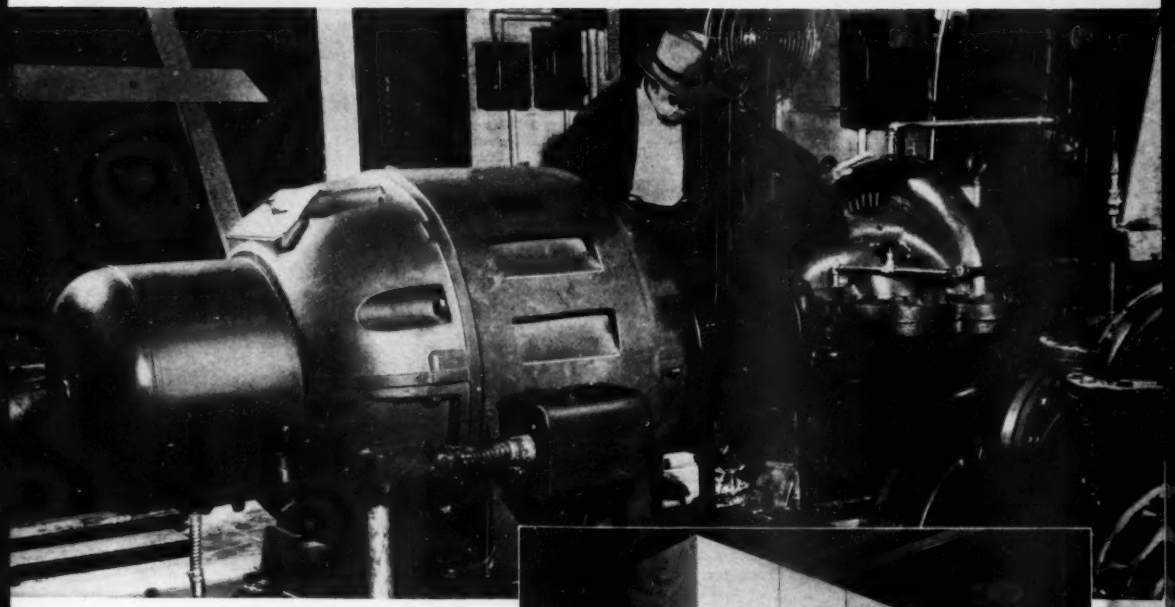


Fig. 4. Insulated welded piping.

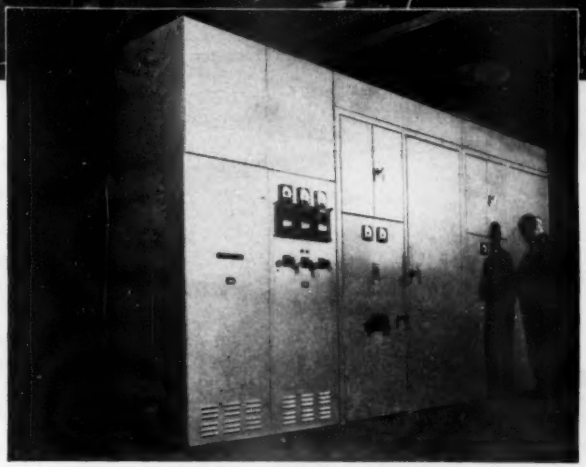
Cohoes, N. Y. protects pumping plant equipment



with G-E Limitamp high-voltage control

Recently, Cohoes installed a new 500-horsepower G-E synchronous motor on a raw water pump. Before they selected control the city engineers wisely decided on a complete study of the power supply. Working with the G-E sales engineer they determined the available short circuit capacity of the system was 60,000 kva. The destructive potentialities of this power obviously called for an "insurance" that would protect their investment.

G-E Limitamp was the "insurance". It answered every need. In addition to controlling the motor, its co-ordinated design, using current-limiting EJ-2 fuses, will clear shorts in less than half a cycle—well before damage can occur to motor or control. Extra dividends in the new smaller size, protection to personnel, reduced installation, engineering, and maintenance costs are inherent in this equipment, too.

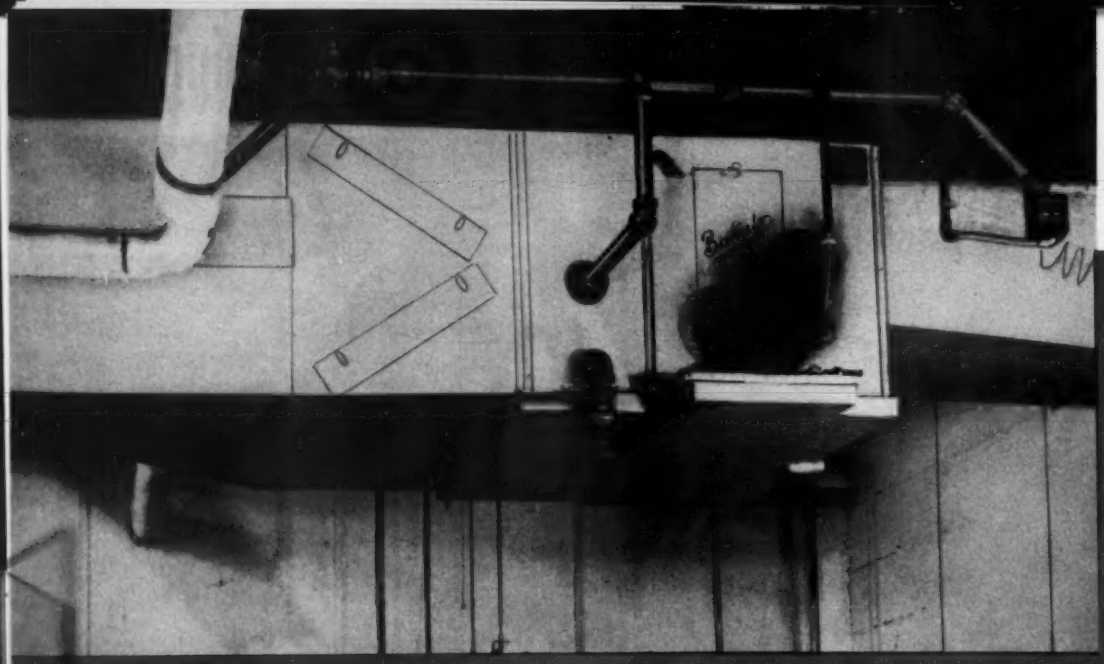


G-E Limitamp installed at Cohoes, N. Y. for control of two 500-horsepower motors

For your high-voltage installation ask for G-E Limitamp—now available in ratings up to 4800 volts with an interrupting capacity up to 250 mva. Protect your power system and motors with G-E Limitamp—more information in Bulletin GEA-5409. Ask the nearest G-E office for this bulletin or write Section 730-23, *Apparatus Dept., General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

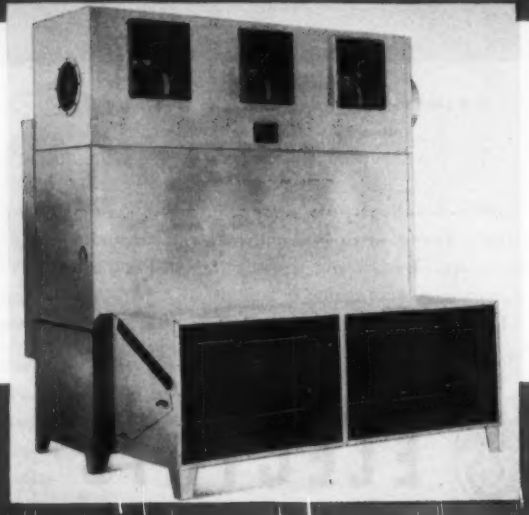
730-23



OVERHEAD and out of the way is this installation of a horizontal model "Buffalo" PC Cabinet. An ideal unit where floor space is short and where there is sufficient headroom. Can be concealed, if desired.

These "Buffalo" WEATHER-MAKERS

...AND PROVIDE DEPENDABLE



NO KNOCKING OUT WALLS

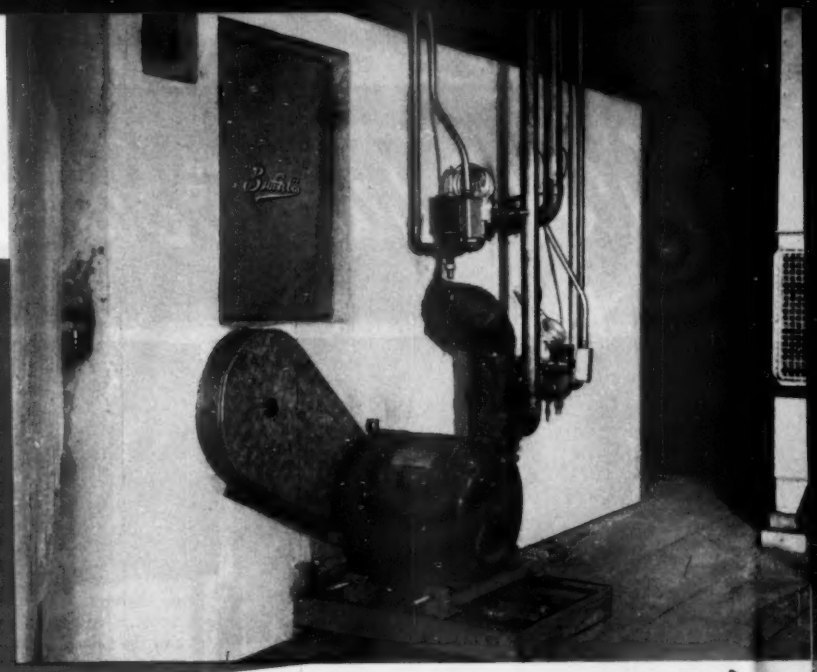
to bring this "Buffalo" VPC (vertical model) Cabinet into your plant. In 3 interchangeable sections, it can pass easily through standard doorways. This makes for simplified maintenance, too. Quality construction throughout includes heavy paneling and hollow shaft fans.

BUFFALO

488 BROADWAY

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

HEATING • COOLING



ON-FLOOR INSTALLATION

of "Buffalo" PCW Cabinet with Air Washer Section, in plant basement. Note insulation. Here are complete centralized air conditioning functions, in one accessible unit.

ARE SPACE-ECONOMIZERS!

Centralized AIR CONDITIONING

FOR LONGER SERVICE AND BEST RESULTS

figure sturdy, efficient "Buffalo" Central Air Conditioning Cabinets in your plans. Central conditioning—one unit for a building, rather than many small units — is far cheaper and more satisfactory in the long run. LET US MAIL YOU BULLETIN 3703, FOR YOUR FILES.

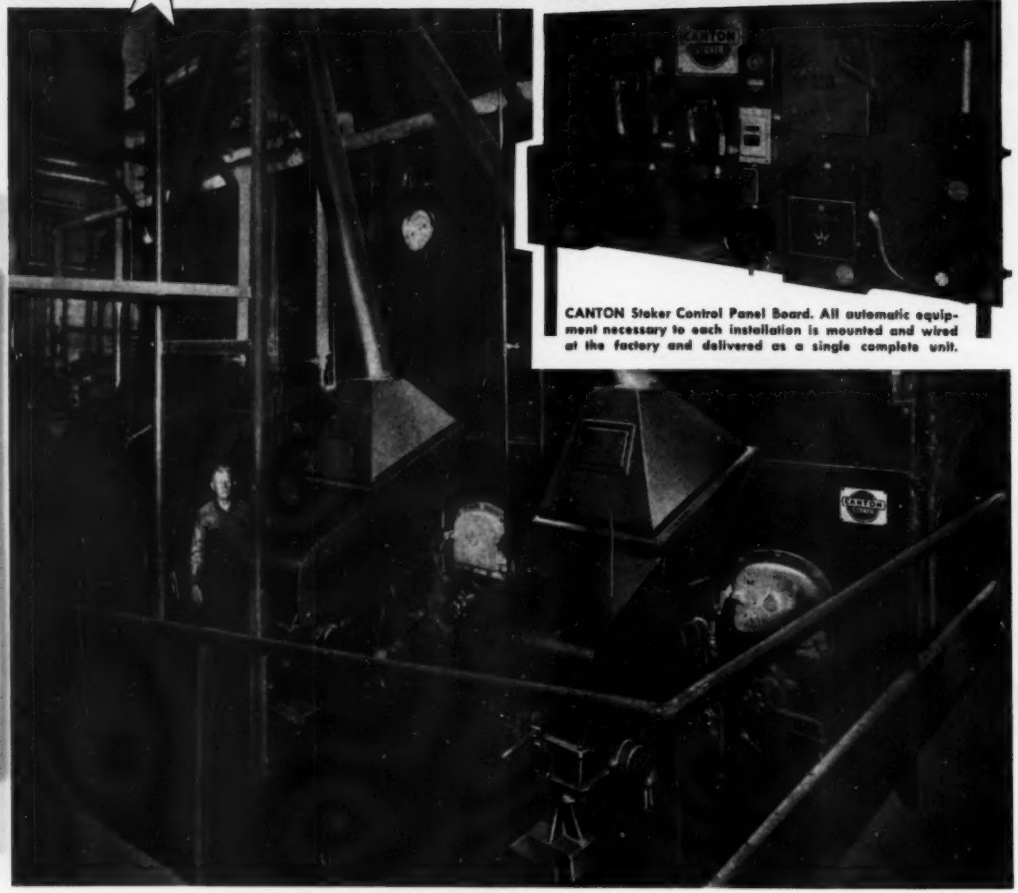
FORGE COMPANY

BUFFALO, NEW YORK

Branch Offices in all Principal Cities

AIR CONDITIONING UNITS

It's No Trick to Save Money



CANTON Stoker Control Panel Board. All automatic equipment necessary to each installation is mounted and wired at the factory and delivered as a single complete unit.

Multiple installation of CANTON Vulcan Ramfeed Stokers under 300 HP Water Tube Boilers at Utah State Capitol Bldg., Salt Lake City, Utah.

CANTON

SINCE 1910

...with a GOOD STOKER!

CANTON STOKERS

During the past forty years, thousands of users have learned that the superior construction and operating features of Canton Stokers provide worthwhile savings. Their dependable and efficient operation is backed by forty years' experience in designing and manufacturing quality stokers with outstanding advantages.

★ Every Canton Stoker is mechanically designed and engineered to give the highest possible operating efficiency for the specific installation in which it will be used.

★ All component parts of Canton Stokers are made of the finest materials—designed, manufactured, assembled, and tested under the rigid Canton "quality-production" policy.

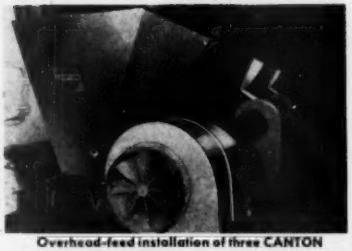
★ Canton manufactures 54 types and sizes of Ramfeed and Wormfeed Stokers to supply a broad range of application requirements. Ramfeed Stokers are equipped with either single or double side-dumping Ash Plates. Wormfeed Stokers are supplied in either dead-plate or side-dumping types.

★ Canton maintains a complete stoker service and parts organization, available any time, anywhere to assure operators a minimum of "down-time" for their stoker equipment.

In addition, the "plus" advantages of substantial fuel and labor savings made possible with Canton Stokers will demonstrate why thousands of users are "sold" on Canton Ramfeed and Wormfeed Stokers for all types of power generating and heating plants.

CANTON STOKER CORPORATION
Andrew Place, S. W., Canton, Ohio
CANADIAN REPRESENTATIVE: Volcano Ltd., 743 Mountain Street, Montreal 3, Quebec
EXPORT DIVISION: W. B. Harkins, 751 Drexel Building, Philadelphia 6, Pa.

For detailed information on Canton Stokers, call or write the Canton Stoker representative nearest you or Canton Stoker Corporation, 741 Andrew Place, Canton 1, Ohio. *Bulletins on Request.*



Overhead-feed installation of three CANTON Vulcan Ramfeed Stokers at the Magnavox Company, Fort Wayne, Indiana.

CANTON Le-Set Stoker with Uniflex Drive showing Synchronized Combustion Control connections, Victor Silk Hosiery Mills, Doylestown, Pa.

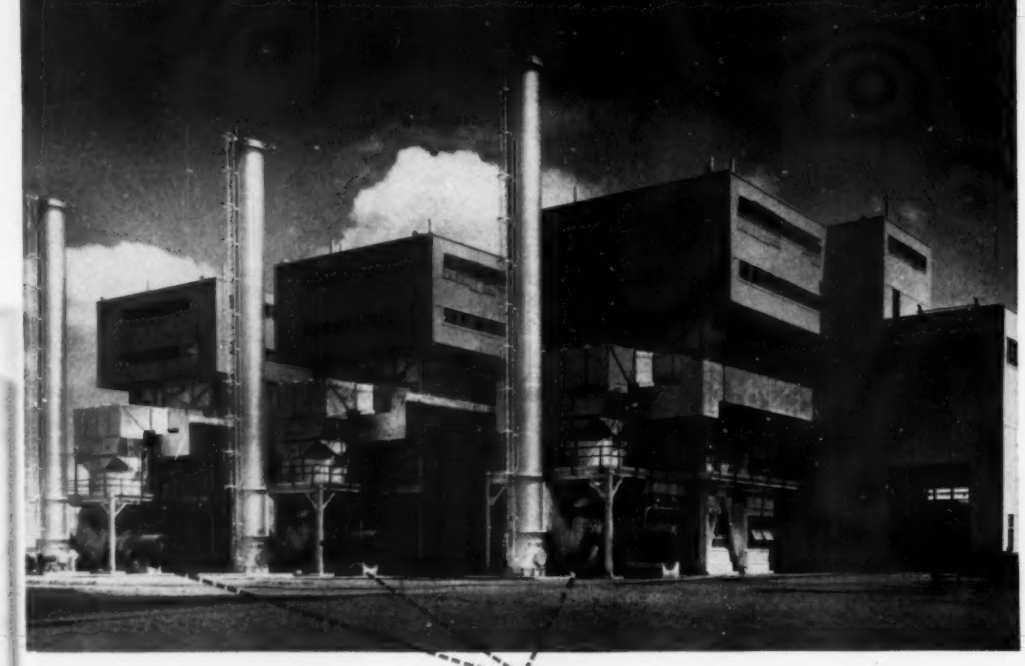
Battery of four CANTON Duraflex Wormfeed Side-Dump Stokers at U. S. Post Office, Buffalo, New York.

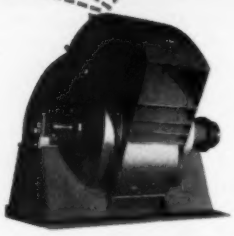
CANTON RAM FEED STOKER DRIVE MECHANISMS ARE GUARANTEED FOR FIVE YEARS

STOKER

CANTON STOKER CORP. CANTON 1, OHIO

No. 3 for Kansas Power and Light!





One of the three 440 HP 875 RPM E-M Magnetic Drives with outdoor enclosures installed at the Hutchinson Station of Kansas Power and Light Co.

IT'S pretty difficult to beat repeat orders as proof of performance. First at Abilene . . . then at Topeka . . . and now at Hutchinson, Kansas Power & Light has made its third installation of 'outdoor-enclosed' E-M Magnetic Drives for precise speed control of draft fans.

When the automatic E-M Regutron Controls call for more or less draft, the E-M Magnetic Drives instantly respond to change fan speed . . . and keep that speed within 1% . . . regardless of load variations.

The E-M Magnetic Drive with Regutron Controls gives the correct air for efficient combustion . . . effects fuel savings . . . holds combustion losses to irreducible minimum.

Learn how you, too, can save on power and fuel bills in your power plant with "economy-engineered" E-M Magnetic Drives. Call, write, or wire your nearest E-M engineer, or write for E-M Publication No. 1078.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

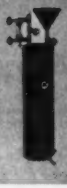
4400-TPA-2094

E-M ADJUSTABLE-SPEED MAGNETIC DRIVES

Reduce

Sludge Deposits, Blowdown Losses!

ALLIS-CHALMERS AKON Treatment for Boilers



FREE Compact Feeders to AKON Treatment Users

LIQUID FEEDER

BRIQUETTE FEEDER

YOU NEED *Akon* treatment in your powerhouse if your boilers are troubled with sludge deposits, oxygen corrosion, excessive blowdown, or carryover. Allis-Chalmers specialists have been recommending *Akon* materials for such problems for nearly twenty years — and early users still specify *Akon* treatment.

SLUDGE COAGULANT

Akon treatments are primarily sludge conditioners. Sludge is prepared for quick, efficient blowdown — and its prompt, complete removal stops the formation of soft scale before it starts. Suspended sludge, which contributes to carryover, is materially reduced by coagulation.

OXYGEN SCAVENGER

In addition to conditioning the sludge, *Akon* materials remove free oxygen from boiler water to stop corrosion. Even traces of residual oxygen from deaerating heaters can prove troublesome if ignored.

PACKAGE TREATMENT

For plants where water softeners are not used, a combination of *Akon* materials and internal softening chemicals has been briquetted to form a package treatment. Compact and easily handled, *Akon* briquettes carry out the entire softening and sludge conditioning job without the need for elaborate feeding devices.

For the *right* answer to any boiler feedwater problem, contact Allis-Chalmers. (Coupon attached for your convenience.)

Allis-Chalmers
Milwaukee 1, Wisconsin

Gentlemen: Please send me —

☐ Bulletin 2887408 on Akon treatment.

☐ Bulletin 28X6176 on Akon briquettes.

OR . . .

☐ Analyze and make recommendations on my problem, data enclosed.

Name .....

Title .....

Company .....

Address .....

City ..... State .....

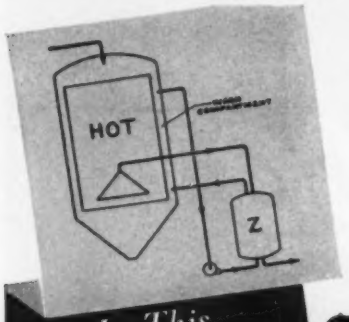
A-3336

Akon is an Allis-Chalmers trademark.

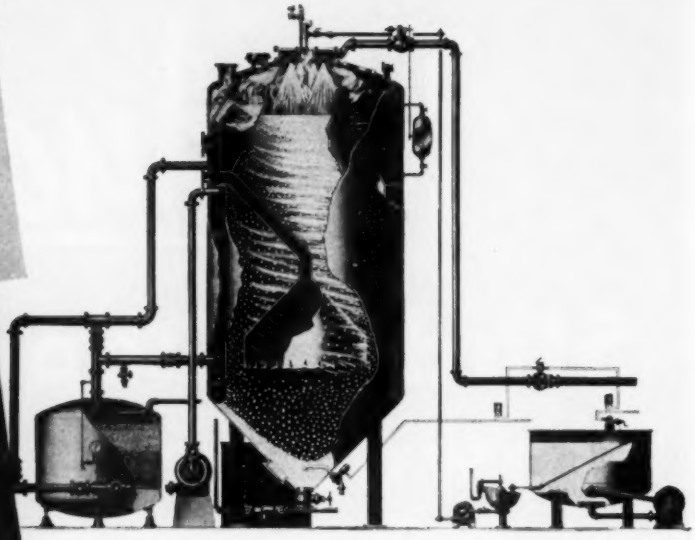
ALLIS-CHALMERS

Water Conditioning

✓ EQUIPMENT ✓ CHEMICALS ✓ SERVICE



In This
WORTHINGTON
HOT-Z
Deaerating Type Water Conditioning System . . .



Built-In Annular Wash Water Compartment Supplies and Reclaims Backwash Water *Independent of the Softening Process*

No other Hot Zeolite System offers you so many advantages as this Worthington Hot-Z System. A quick review of the vital facts will show you why.

As you probably know, Hot Zeolite beds require periodic expansion to minimize packing and friction loss, and to insure efficient contact of each Zeolite particle with its share of dissolved impurities. This need for bed expansion occurs not only during the regeneration routine, but also several times during the period between regeneration routines. That's why it is important for you to use clean, softened water, preferably at normal operating temperature, for the reverse flow or "backwash" operation.

Worthington does it!

The Worthington Standard Hot-Z System with its backwash feature provides a built-in annular wash water compartment that supplies and reclaims backwash water . . independent of the system's softening process. In this compartment, backwash water is cleaned and maintained at normal operating temperature.

This backwash feature pays off particularly in systems employing filters because it *makes filter beds last as long as eight years.*

Other advantages

Worthington Hot Process Systems come equipped with modern, direct contact vent condensers. This means, no more of the scaling trouble that made the old-fashioned shell and tube types such a nuisance.

In addition, Worthington Hot-Z Systems operate on low-priced lime and salt. That's why the average installation saves enough in chemical costs to pay for itself in 3 years.

Get all the facts!

It will pay you to investigate the Worthington Hot-Z System thoroughly. Tell us your conditions of service and get our recommendation in terms of dollars and benefits. You'll find in our Hot-Z System, as in so much other equipment, *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Section, Dunellen, N. J.*

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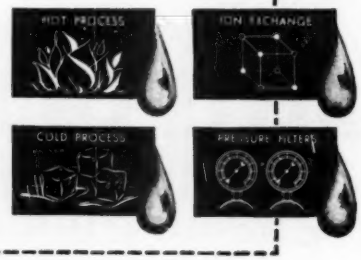
WORTHINGTON

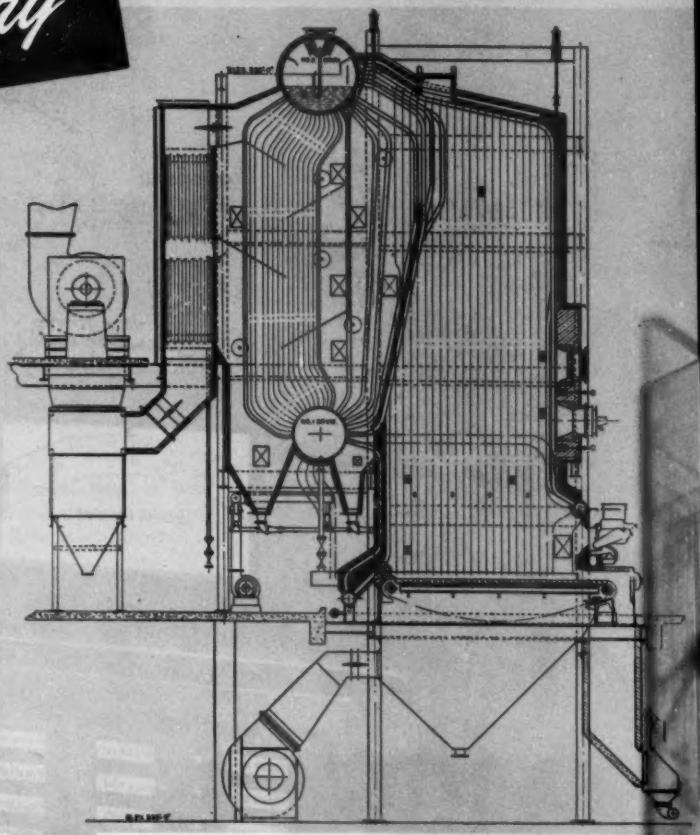
WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



REPEAT ORDERS tell the story

...of complete satisfaction!



Again CATERPILLAR TRACTOR CO. is getting additional Springfield Steam Generating Units—this time for the company's Tractor Plant at Joliet, Illinois. They add 160,000 lbs. of capacity to the four units previously installed in Peoria.

"Caterpillar" is one of the many leading American industrial organizations that have placed their seal of approval on Springfield with REPEAT ORDERS.* *For Steam Generating Units that "are built to stay modern longer," check with Springfield now!*

Springfield Boiler Co. specializes in the production of a complete range of steam generating equipment ... ANY SIZE ... ANY PRESSURE ... ANY TEMPERATURE ... AND FOR ANY FUEL. Springfield is organized to apply the same engineering skill to all contracts, large or small. We will be glad to submit a proposal covering your requirements.

*For a complete list, see your local Springfield Representative.

Check with Your Consulting Engineer on Modernization and New Plant Projects

2 New Springfield Units

The above drawing shows the arrangement of the two new Springfield units for the Joliet, Illinois, plant of Caterpillar Tractor Co.

UNIT CAPACITY—80,000 lbs. per hour, continuous; 90,000 lbs. per hour, two hour peak at 150 psig saturated.

DESIGN EFFICIENCY—82.85% at 80,000 lbs.; 82.2% at 90,000 lbs.

FIRING—American Engineering Co. Spreader Stokers. One unit equipped with auxiliary gas burners.

AUXILIARIES—Springfield Economizer, Dust Collector, Forced and Induced Draft Fans, Controls.

SPRINGFIELD BOILER CO.

1953 E. Capitol Ave., Springfield, Illinois, U.S.A.

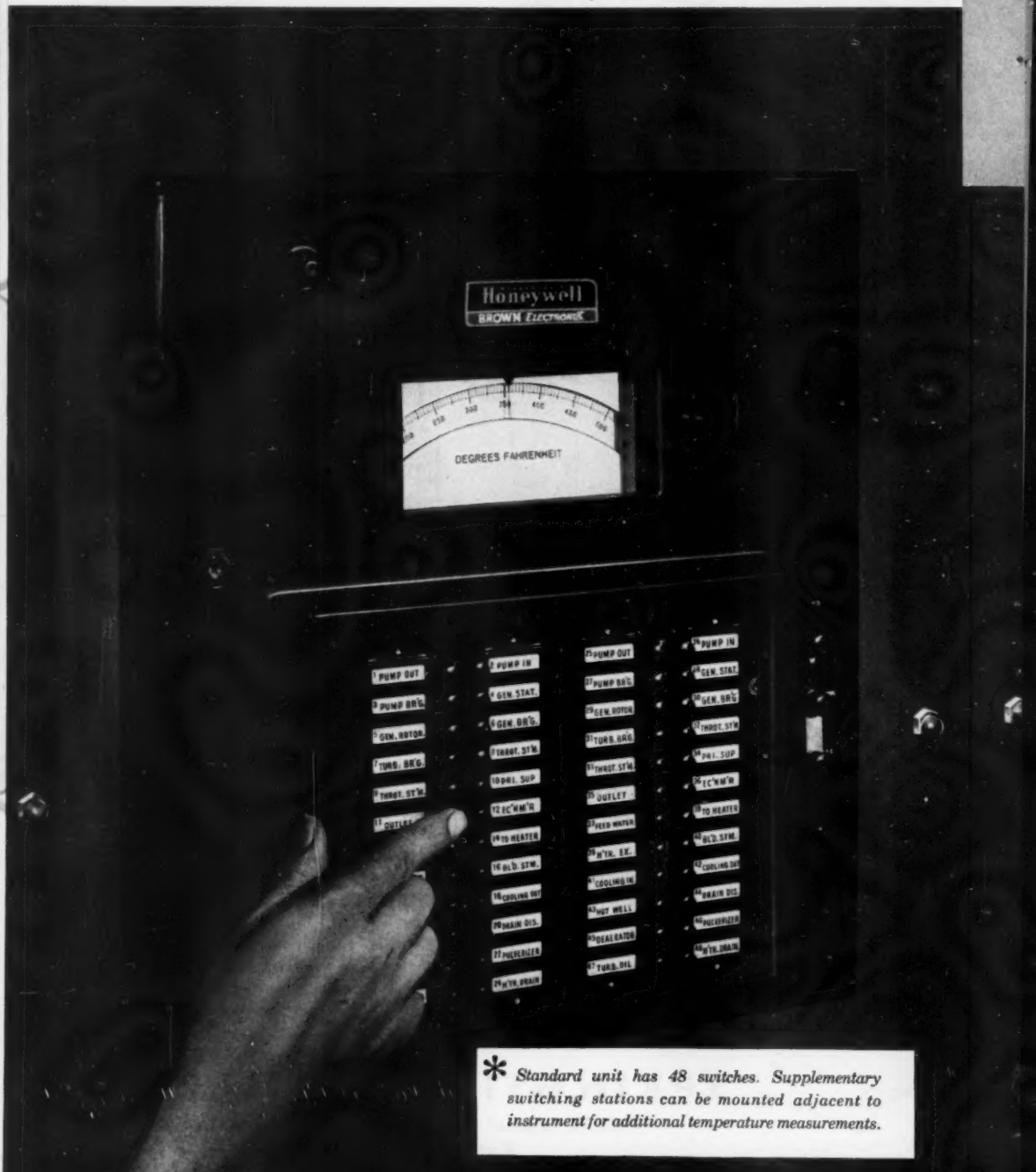
Worldwide Sales and Service

See Our Catalog in SWEET'S

BENT TUBE BOILERS • STRAIGHT TUBE BOILERS • SUPERHEATERS • DESUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATERWALLS • PACKAGE BOILERS • COMPLETE STEAM GENERATING UNITS

MINNEAPOLIS Honeywell
BROWN INSTRUMENTS

. . . Symbol of Simplified Operation and Maintenance



* *Standard unit has 48 switches. Supplementary switching stations can be mounted adjacent to instrument for additional temperature measurements.*

Push the buttons *

READ THE TEMPERATURES

(from one central location)

. . . with the *ElectroniK* PRECISION INDICATOR

From central panel board to the farthermost areas of your plant, the *ElectroniK* Precision Indicator can give you accurate temperature readings of 48 (or more) pieces of equipment . . . without moving a step!

A simple push of a switch-button instantly and accurately "tunes" you in to a specific location. Button stays in until another is pushed . . . permitting logging of temperatures, when required. Just install thermocouples at the points from which you desire temperature readings and connect them to the instrument.

The *ElectroniK* Precision Indicator has a calibrated accuracy within $\pm 1/3\%$ of scale span for spans of 10 mv or greater . . . within ± 0.020 mv for spans less than 10 millivolts.

The sensitivity of the *ElectroniK* Precision Indicator is $1/32$ of 1% of scale span for spans in excess of 16 millivolts and 0.005 mv for spans less than 16 millivolts.

Available in universal case for flush or surface mounting. Dust and moisture proof.

For detailed information write for Specification Sheet 176 or call your local Honeywell engineer . . . he is as near as your phone. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4490 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

MINNEAPOLIS **Honeywell**

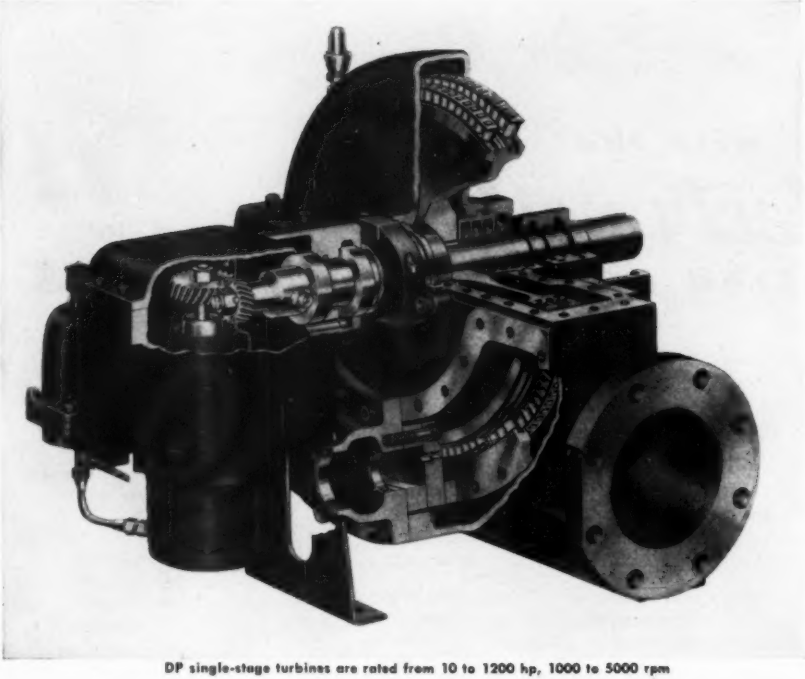
BROWN INSTRUMENTS

Partial List of Users

E. I. du Pont de Nemours & Co.
Baldwin Locomotive Works
General Electric Co.
Niagara Mohawk Power Co.
Argonne National Laboratories
Buffalo Niagara Elec. Corp.
Philadelphia Electric Co.
Texas Electric Co.
West Penn Power Company
Public Service Co. of Northern Illinois
Wisconsin Electric Power Co.
Hope Natural Gas Co.
Stancal Asphalt & Bitumuls Co.
Allison Division of G M C
Curtis Wright Corp.
Armco Steel Corp.
Texas Company
Shell Oil Company
International Harvester Co.
Esso Standard Oil Co.
Boren Clay Products
Valentine Firebrick Co.
Sun Oil Co.
Philco Corporation
American Thermos Bottle Co.
Pontiac Motors Div. G M C
Norwich Pharmaceutical Co.
Purdue University
University of Minnesota
Tufts College
Great Atlantic & Pacific Tea Company
Packard Motor Car Co.

Now More Than Ever . . .

YOUR BEST TURBINE



DP single-stage turbines are rated from 10 to 1200 hp, 1000 to 5000 rpm

Type

DP

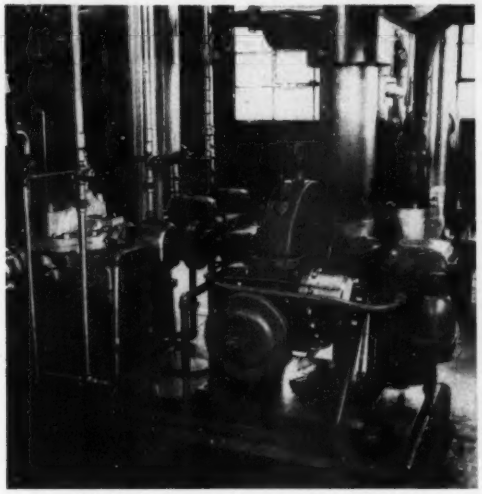
Since the introduction of the DP turbine, more than two years ago, General Electric has been telling mechanical-drive turbine users that their best turbine buy was a *standard* design, wherever it could be properly applied. Nowadays, with the emphasis on increased output, the advantages which turbine standardization offers are even more important.

Standardization means that turbines of different rating and size have mostly identical construction features. This speeds delivery, cuts manufacturing costs, makes possible a better design and a better turbine. If you're not familiar with the General Electric DP, we suggest that you contact your nearest G-E sales office or send for a copy of bulletin GEA-4955, "A New Standard in Mechanical Drive Turbines." Write to *Apparatus Dept., General Electric Company, Schenectady, N. Y.*

GREATER RELIABILITY

From its totally enclosed governor to its durable babbitt-faced bearings, General Electric's DP turbine is built to provide greater productivity through greater reliability. Standardization has made possible "extras" such as pressure lubrication, Monel-sprayed shaft, self-positioning packings, a totally enclosed hydraulic governor. You can count on your DP for safe, dependable service in hazardous atmospheres and on tough, continuous-process assignments.

DRIVE IS A STANDARD



This DP drives a centrifugal pump in a refinery

WIDE APPLICATION FLEXIBILITY

In plants which require shifting of equipment from job to job, a standard DP frequently eliminates the need for extra drives. Because most parts are identical for all ratings, speed range and shaft horsepower can be easily and economically changed to fit new conditions. Though the DP's 30% adjustable speed range is usually adequate, a new range can be set anywhere from 800 to 5000 rpm simply by substituting a new emergency governor and governor gears. A change in horsepower rating usually requires a new nozzle plate and a few valve parts. These parts are all available on immediate delivery and save the expense of a new turbine which would be required with a less flexible, non-standard unit.

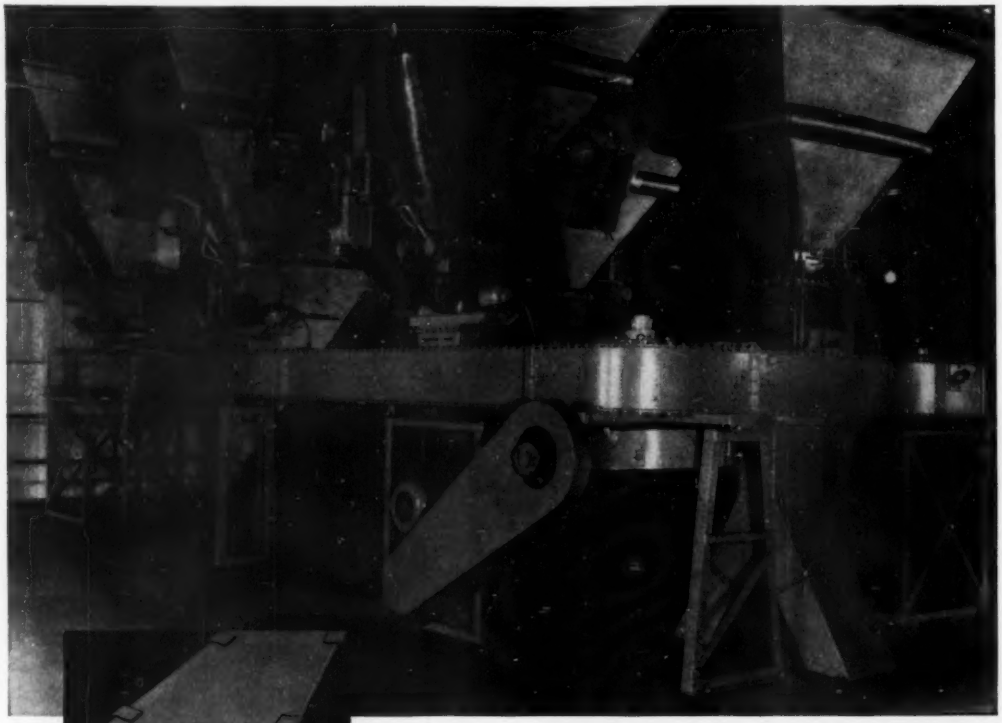
Standard spare parts kits are available with all DP turbines

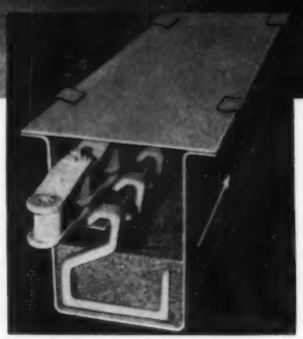
EASIER, QUICKER MAINTENANCE

Because most parts of standard DP's are interchangeable on all models, spares can be easily stocked, and maintenance work handled quicker. You can have delivered with the turbine a 91-item spare parts kit, sufficient to service several machines. Socket-head cap screws are used throughout for quick disassembly. Standard shaft height, keyways, and coupling fits simplify installation. You can move DP's from job to job without change in the base structure.

GENERAL ELECTRIC

252-49





Cross section through side-pull type REDLER casing shows skeleton flights linked together with conveying element of flights suspended in lower half of totally-enclosed casing and chain links traveling on a track guide. Jointed chain makes a complete horizontal circuit around drive and idler corners of conveyor.

A horizontal, closed-circuit REDLER Conveyor, mounted under six hopper-bottom fly ash bins, receives the cottrell dust through S-A rotary air-lock gate-regulated feed openings. Dust is conveyed around a circuit to discharge outlet through which it is dispatched by 2-way discharge chute to pug mills on the floor below. Capacity: 20 tons an hour. A recirculating feature, unique in the REDLER, permits any dust not discharged at the outlet to recirculate until drawn off.

WANTED: Good Housekeeper for Generating Station

REDLER Conveyor Solves Dust Handling Problem

The basic need in this plant was a handling unit that would reclaim cottrell dust from fly ash bins and convey it to pug mills where ash could be prepared for disposal. S-A engineers recommended, adapted and installed a sealed casing REDLER Conveyor that moves the dust in ample volume *without loss, leakage or spillage*—thereby contributing to a clean station. This compact, space-saving REDLER Conveyor fully satisfies every requirement. If you have a material handling problem, no matter how large or small—we invite you to draw on S-A's cumulative experience of 50 years in engineering and manufacturing. *Write today, without obligation, for complete information.*

1901-1951

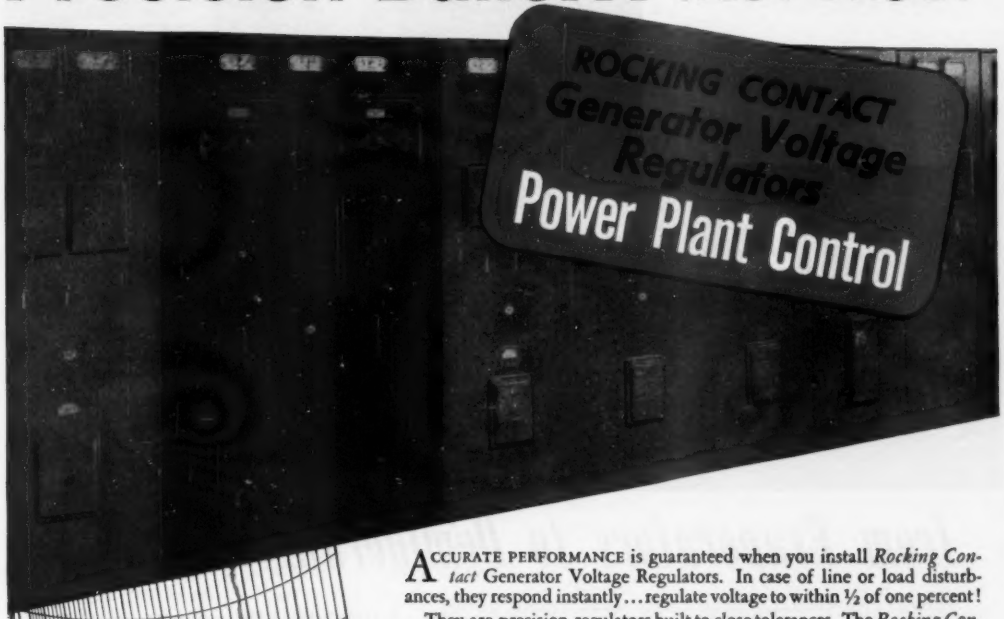
50 years experience with bulk handling

STEPHEN S-A ADAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois · Los Angeles, Calif. · Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

Precision Built... FOR ACCURATE RESPONSE!

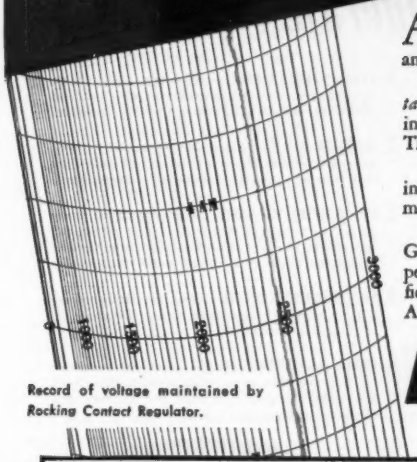


ACCURATE PERFORMANCE is guaranteed when you install *Rocking Contact* Generator Voltage Regulators. In case of line or load disturbances, they respond instantly... regulate voltage to within ½ of one percent!

They are precision regulators built to close tolerances. The *Rocking Contact* commutator, for instance, is machined to within one thousandth of an inch. A silver surface is added to form a low resistance contact surface. Then the commutator radius is hand polished to friction-free smoothness.

All moving parts are tested and adjusted for perfect balance, then fitted into jeweled bearings. Resistance elements are individually designed to match the characteristics of your generator exactly.

It is this exacting design and workmanship that give *Rocking Contact* Generator Voltage Regulators their long lasting accuracy . . . "Not one penny spent for maintenance in fifteen years of continuous service," typifies the service users are getting. Call your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin for more information.



Record of voltage maintained by *Rocking Contact* Regulator.

ALLIS-CHALMERS

Rocking Contact and *Synchro-Operator* are Allis-Chalmers trademarks.

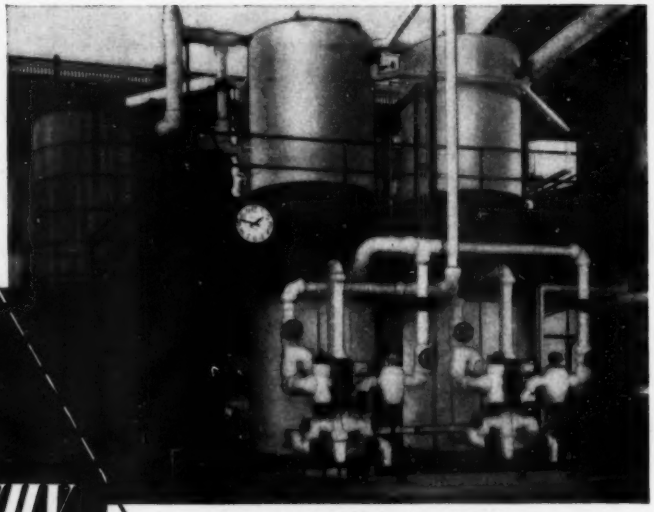
Automatic Speed Control for Boiler Draft Fans

Draft fans operate at exactly the required speed for perfect combustion when Allis-Chalmers Type 257 Liquid Rheostats are used with wound rotor drive motors. Allis-Chalmers Liquid Rheostats are "application engineered" to provide straight line speed characteristics. Wide range stepless speed control is provided automatically . . . electrical, pneumatic or hydraulic pilot devices can be used. Write for Leaflet 14S7544.

Automatic Synchronizer for Rotating Machinery

The *Synchro-Operator* (shown on the control panel with the *Rocking Contact* Regulators) controls the speed of synchronous condensers, alternators and frequency changers to bring them into synchronism automatically. While doing so, it indicates relative speed, the faster machine, phase angle between machines, and the exact point of synchronism. It automatically closes breaker at the exact point of synchronism. Only one *Synchro-Operator* is needed for any number of machines. Leaflet 14S6386B.

A-3294



Pioneer Demineralizer Installation—Central Station Makeup

5 REASONS WHY Central Station Shifted from Evaporators to Demineralized Makeup

Early in 1950 INFILCO helped make water treating history. The first complete demineralizing plant ever installed to treat *boiler makeup water in a central station* was put into operation.

This demineralizing and silica removal plant replaces evaporators previously used on three of the most recently installed boiler units. It is expected to eliminate any need for evaporators on a scheduled 1800 psi unit. Treatment equipment consists of three sets of Catex®-Anex® demineralizing and silica removing units with one aerating tower for the removal of carbon dioxide. Infilco "F" Valves afford automatic operation of the demineralizers.

Without obligation, discuss your "power" water problem with Infilco's competent Field Engineers. They are strategically located in principal cities. Or write our executive offices in Tucson. Further data on this "pioneer" installation is available as well as information on other outstanding Infilco water treatment equipment.

1. **ASSURED AMPLE SUPPLY**.. *demineralizers can always operate at rated capacity whereas evaporator output varies with turbine load and evaporator condition.*
2. **IMPROVED QUALITY**.. *demineralized water is consistently low in dissolved solids content and practically free from corrosive CO_2 produced in evaporators.*
3. **LOWER OPERATING COSTS**.. *turbine cycle efficiency so greatly increased that it more than offsets demineralizer chemical costs. Phosphate requirements for internal boiler water control drastically reduced.*
4. **LOWER LABOR COSTS**.. *complete demineralizer plant automatic in operation, except for charging regenerating chemicals.*
5. **LOWER MAINTENANCE COSTS**.. *minimized corrosive CO_2 content reduces corrosion problem throughout the feedwater system, boilers and turbines and eliminates costly evaporator cleaning.*

SERVING THE POWER PLANT FIELD WITH WATER CONDITIONING EQUIPMENT THAT'S

Quality Engineered for Quality Performance

INFILCO INC.

TUCSON, ARIZONA

WITH OFFICES IN PRINCIPAL CITIES

INFILCO

BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

PHILIP SWAIN, EDITOR • APRIL 1951 • ESTABLISHED 1882

Power
COMBINED WITH OPERATING ENGINEER

An Announcement to All Readers of Power

YOU NOW HOLD in your hands the first number of a new and greatly expanded POWER magazine—more articles and departments than ever before.

But mere numbers don't tell the story. The big news is that POWER has been vastly broadened and enriched by merging into its pages and its editorial staff those of its sister publication, *Operating Engineer*.

As many of you know, we started *Operating Engineer* in January 1948, to render a new type of intensely practical editorial service to the engineers primarily concerned with the everyday problems of power-service operation and maintenance. The great popularity of *OE* was attested by a steady stream of fan mail and by the growth of paid subscribers to 26,500 in two years.

After allowing for a slight overlap, the merger increases the number of POWER subscribers to about 47,000, a figure never before approached in this field.

This merger of two great publications brings the whole range of responsible power jobs into a single fraternity of readership. Now, to a degree never before achieved, a single magazine delivers a completely rounded engineering service to the thousands of power men who refuse to stay put on one side or the other of the imaginary line that divides the "practical" from the "professional."

Many signs have indicated a growing need for this unification—notably the common practice of borrowing the "other magazine"—POWER or *OE*, as the case might be. Many POWER readers felt the need of the operating and maintenance know-how to be found only in *OE*. And many *OE* readers, though greatly pleased with the practical service they were getting, were not content to stop there—wished to build themselves up along professional lines as well.

Now everybody can have both—all within a single cover. From now on you take your choice—read what you want, as your needs dictate.

Yet your editors have taken great care that this union should, in no sense, become a shuffle. We believe that a publication, like a plant, should be engineered for convenience and efficiency with a "place for everything and everything in its place." So your new POWER is divided into three clearly marked sections where you may quickly find what you want when you need it.

Part 1, *Engineering and Management*, brings you many professionally slanted articles, just the sort of material you have found so serviceable in POWER in the past.

Part 2, *Plant Operation and Maintenance*, carries the intensely practical how-to-do-it articles and departments, precisely what *OE* readers have been getting in scope, form and substance. Here are articles on the maintenance and operation of all the power services, plus these departments: Practical Ideas, Plant Problems, Arguments, How to, Headwork and Marmaduke Surfaceblow. By the way, note that Practical Ideas and Plant Problems replace and expand Power Engineers' Notebook and Problems from the Plant, formerly carried in POWER.

Every reader will have his natural preference for Part 1 or Part 2 according to the normal emphasis of his job, but most of you will browse through both sections looking for useful information.

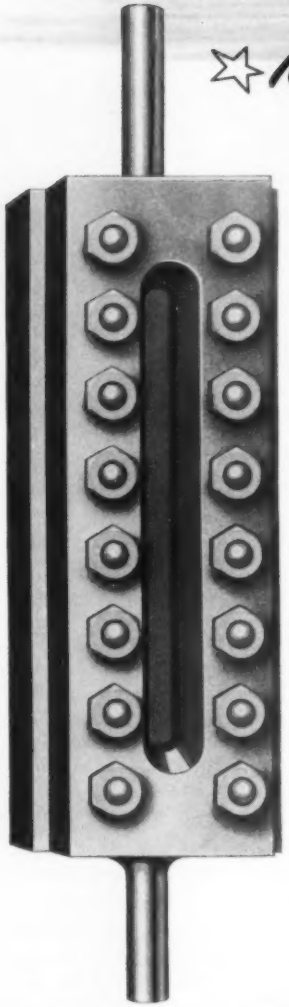
And, of course, all POWER and *OE* readers will be at home in Part 3, *Reader Service Section*, comprising Power News, Technical Briefs, Equipment News, New Bulletins and Bookshelf.

To sum up, whether you have been reading POWER or *OE*, you will find here every service you have known, well arranged for your reading convenience, plus many valuable articles and departments not before available unless you borrowed the other fellow's copy.

You are the judge of the result. Here's your new POWER. Go through it, cover to cover. Read what you like. And let us have your frank comments.

Reliance design formula for high pressure water gage inserts:

☆ *extra rugged bodies*
☆ *restricted window length*



Built to provide increased safety and to help you keep maintenance and replacement low

• The problem of providing safe, efficient boiler water gages has become more important, and more *difficult,* as operating pressures have increased. The transparent window, of course, creates the problem. Glass is highly transparent but is particularly difficult to house—is not recommended for pressures above 1500 psi. Mica can be clamped securely without danger of breakage, but is less transparent than glass. Mica windows can be used on any pressure to 2000 psi. Both materials require carefully engineered housings to offset the stresses to which they are subjected and to facilitate maintenance.

Reliance engineering has developed highly dependable housings for both these materials. Rugged insert bodies have extra wide body bars to minimize "breathing" stresses; clamping pieces are sturdy—are accurately machined for effective precision fit against gaskets and window medium; high tensile studs pass *through* the housing bar, as near to its center as possible, so that clamping pressure from the studs cannot warp the insert when it is assembled.

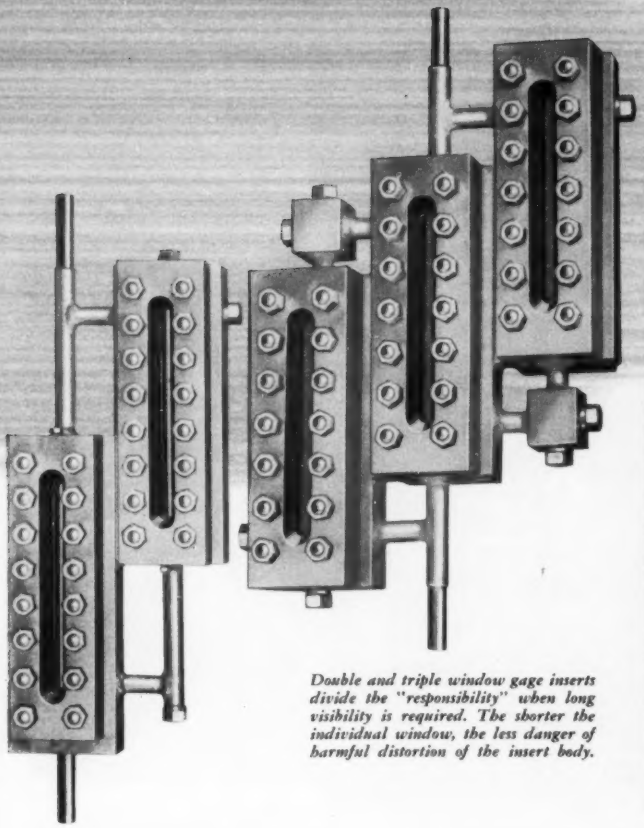
Experience and tests have shown that the housing and transparent medium should be as short as possible. Should the required visibility indicate a long window, it is better to use several short overlapping windows. Thus the various stresses are minimized, reducing the frequency of breakages or blow-outs; and considerable money is saved in the lower cost of shorter glasses, mica protectors (used to protect flat glasses from erosion) and mica windows. Reliance limits the window length to a safe maximum dimension according to pressure range.

A more complete discussion of this subject is found in the Reliance catalog sheet "Design Factors in Building Reliance Water Gage Inserts". Ask for Section B3.X.

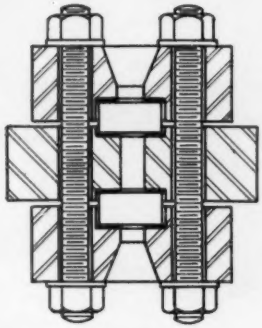
THE RELIANCE GAUGE COLUMN COMPANY
5902 Carnegie Ave. • Cleveland 3, Ohio

Reliance Boiler Safety Devices include Water Columns, Gage Valves and Inserts, Gage Illumination Equipment and other trim for all working steam pressures. Also EYE-HYE, the original all-hydrostatic remote reading water level indicator.

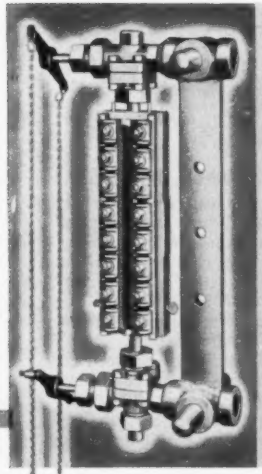
The name that introduced safety water columns.



Double and triple window gage inserts divide the "responsibility" when long visibility is required. The shorter the individual window, the less danger of harmful distortion of the insert body.

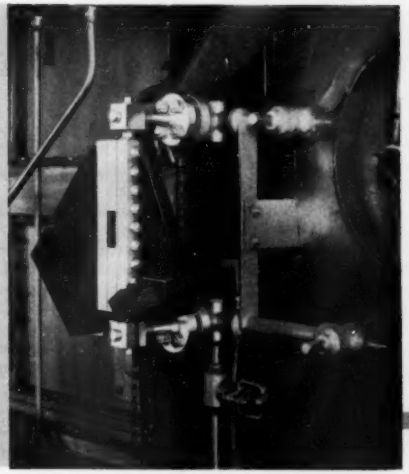


Experience has shown that the most satisfactory high pressure gage insert construction includes a body of sufficient width and strength to resist deflection from high pressures and temperatures, with clamping studs placed as near as possible to the center of the housing bar. Studs pass entirely through body and clamps to avoid warpage from clamping pressure.



For direct-to-drum gage installations, various combinations of Reliance Gage Valves, Gage Inserts and Illumination are available in standard or special assemblies.

The assembly at left incorporates the new Reliance 900 lb. Gage Valve with *removable packing box* which permits efficient re-packing and servicing away from the hot drum. The complete assembly at right uses Reliance Forged Steel Valves No. SG477 rated up to 2000 psi. Write for Section B7.1 describing direct-to-drum assemblies.



...in 1884

Reliance®

BOILER SAFETY DEVICES

COMMERCIAL BUILDINGS

PRIVATE HOMES

CLUBS

FUNERAL HOMES

BANKS

Here's how BYERS SNOW MELTING SYSTEMS Came Through Last Winter's Toughest Tests

Last winter's record-breaking snowfalls gave Byers Snow Melting Systems a real workout. The above illustrations are typical of the results and suggest the wide variety of applications using this modern snow removal method. The coils of Byers Wrought Iron pipe, embedded in the sidewalk or pavement and carrying hot water-anti-freeze solution, made the heaviest snow vanish magically as it fell.

Satisfied users everywhere are constantly adding new chapters to the snow melting success-story. Householders find snow melting an economical luxury. Stores, hotels and service stations have cut excessive snow removal costs and enjoy increases in patronage. Industrial plants keep shipments moving, ban lost time at shift changes by using snow melting systems in loading platforms and access roads. This ever-increasing acceptance is explained by remarkable performance records like those above.

Byers Wrought Iron pipe is ideally suited for this service because of its combination of essential qualities. Its corrosion resistance has been repeatedly proven. Its heat emission is high. It is easily formed and welded. It expands and contracts at virtually the same rate with concrete. And it has ample mechanical strength to withstand damage during installation.

NEW BULLETIN ON SNOW MELTING. This new bulletin covers the entire field of snow melting—design, installation, operation . . . and explains why dependability demands the use of Byers Wrought Iron pipe. Write for your copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

WHY WROUGHT IRON LASTS

This notch-fracture test specimen illustrates the unusual fibrous structure of wrought iron—which is responsible for the unusual corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

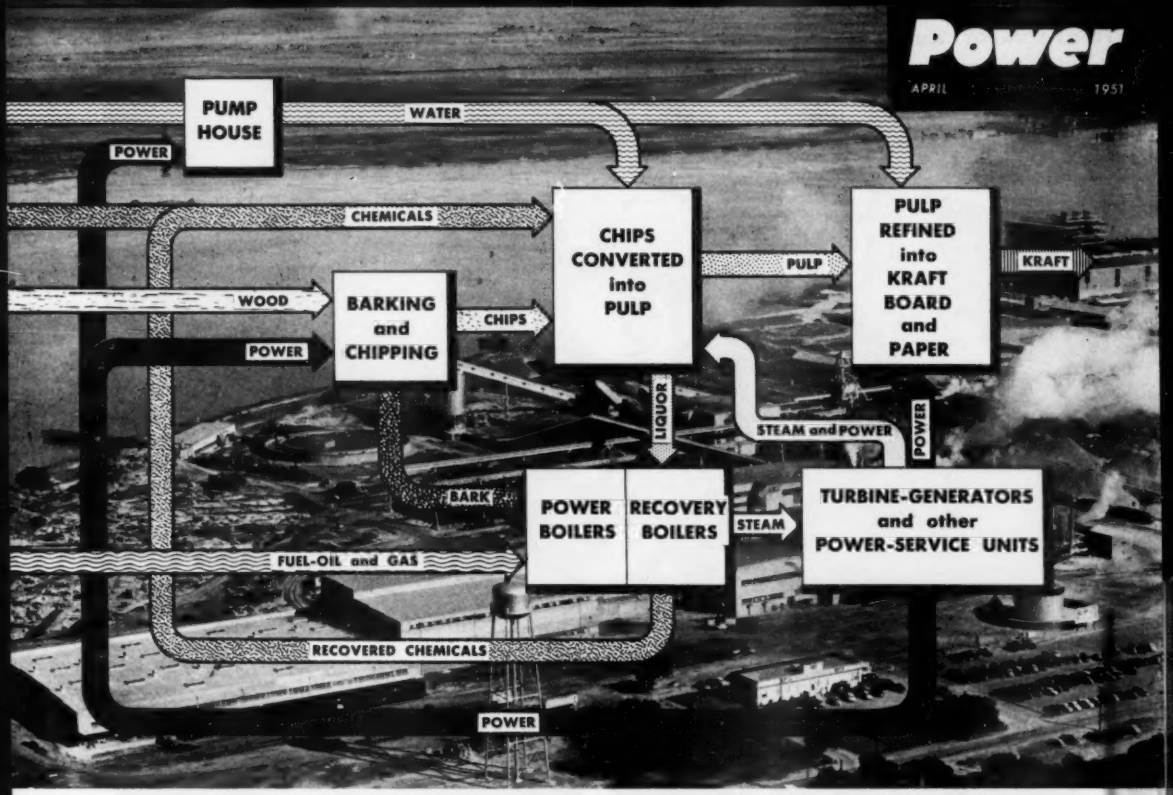
BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



EFFICIENT USE of wood byproducts and heat from chemical recovery reduces need for purchased fuel, spells out the . . .

Formula for Paper-Mill Power Economy

Today's paper mill uses higher-pressure process steam, greater power to steam ratios. Hugh J Byrne of Leland S Rosener, engineers, tells how the latest plant of Fibreboard Products meets the problem

► BLEED AND EXHAUST PRESSURES from paper-mill turbine-generators are going up because, for example, higher paper-machine drying-roll pressures and temperatures produce more paper with no change in investment. That appeals to management. But with increase in bleed and exhaust pressures, less electric power is generated by the steam.

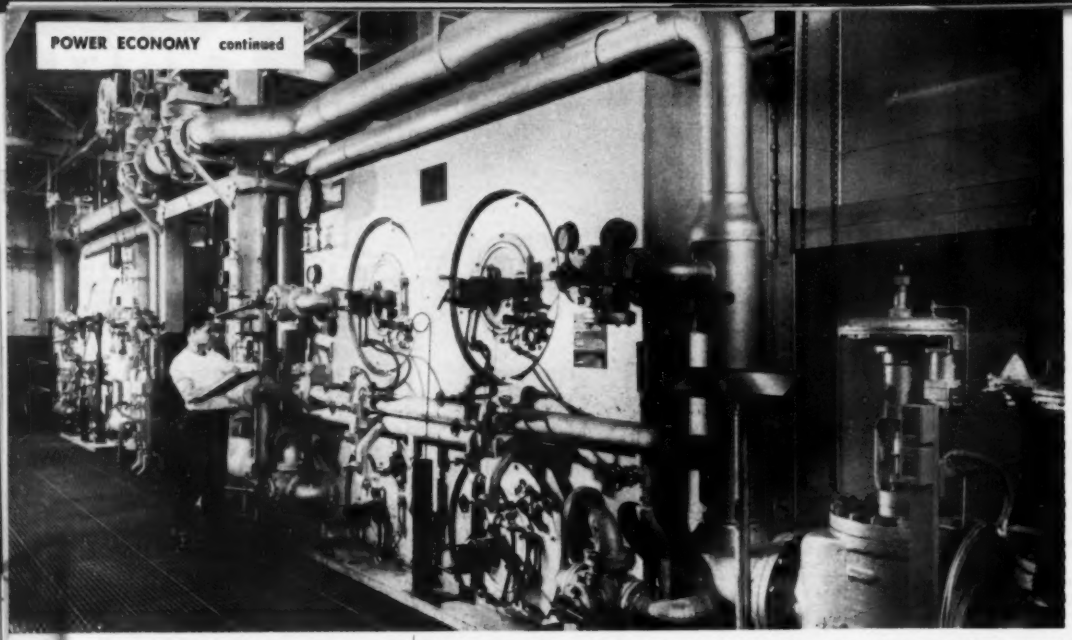
We know fuel cost of power generated by full-condensing operation runs four times as high as for noncondensing. When you add to the industry's trend to higher pressures for process both higher fuel costs and increased ratio of power deraands to low-pressure steam, you need a well-thought-out power plant.

At the East Antioch, Calif. plant of the Fibreboard Products, Inc, the use of up-to-date power-plant equipment operating from higher steam-pressure levels gave the lowest-cost power services. In the 1930's, many mills put in 400-450 psi plants, but today 600 psi is warranted and in some instances as high as 900 psi. What's more, the power plant has to be built for continuity of service, simplicity and economy in operation.

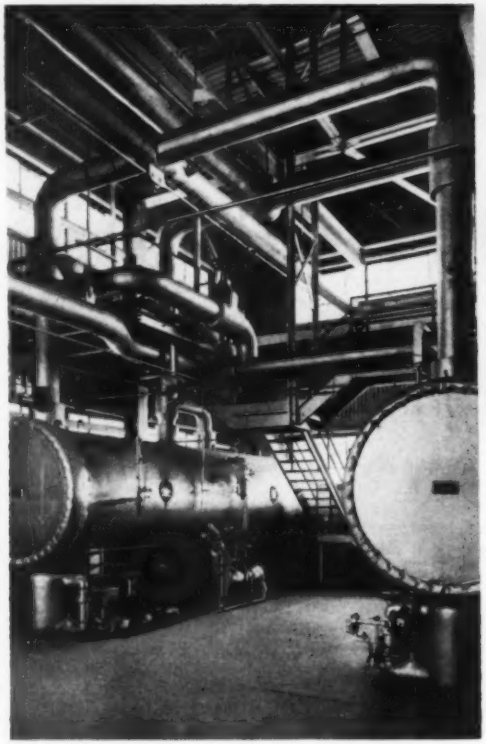
From the building construction to the final equipment we worked to meet this requirement. We have used no walls between turbine and boiler rooms for example. Similarly, there are no division walls between areas including different types of equipment.

All modern paper-mill plants recover the black liquor left over after the pulp has been separated from it. This black liquor carries many of the chemicals used in the pulp-making stage. This liquor when burned gives off enough heat to make steam generation from this fuel a valuable part of the over-all power picture. So steam from this source amounting to 109,000 lb per hr plus that from two 160,000-lb-per-hr oil- or gas-fired steam generators supplies all the 575-psi 700-F steam needed for both process and power.

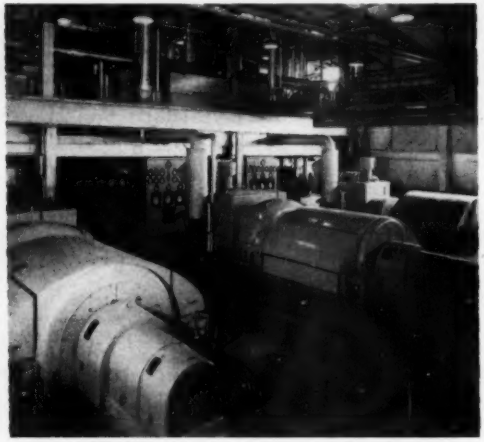
(*More on next page*)



STEAM GENERATION comes from two 160,000-lb-per-hr 575-psi 700-F oil- or gas-fired units, plus a black-liquor recovery boiler delivering 109,000 lb per hr of steam at 575 psi and 700 F. This pressure level is typical of many larger mills



FEEDWATER MAKEUP evaporators operate single effect in parallel; double or triple effect, as power, steam, makeup change

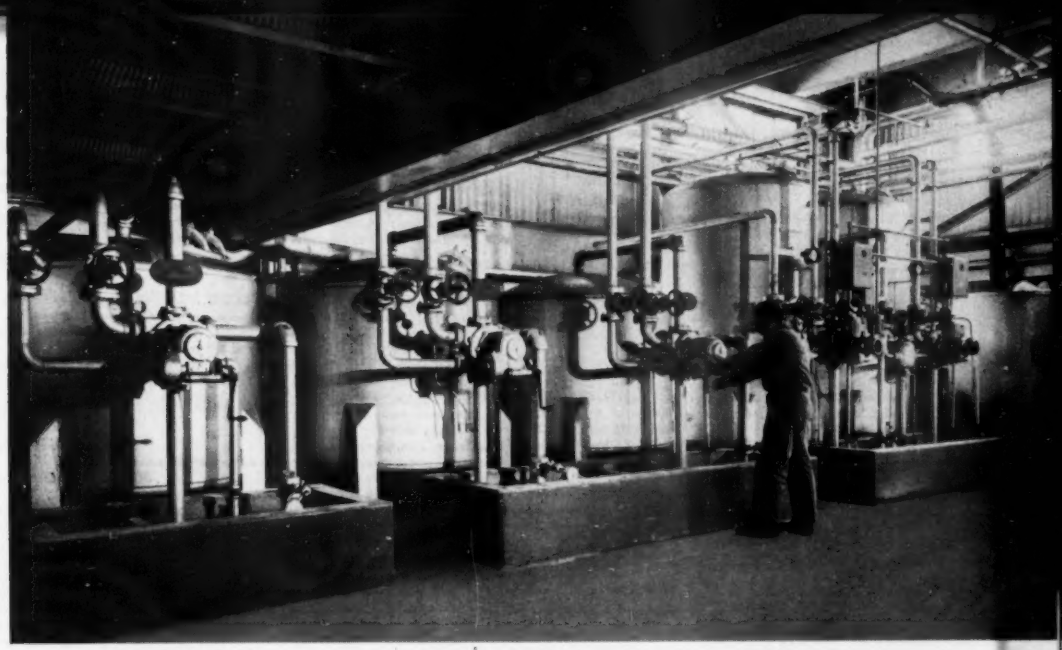


POWER GENERATED by two double automatic condensing and a single automatic noncondensing turbine gives low-cost energy

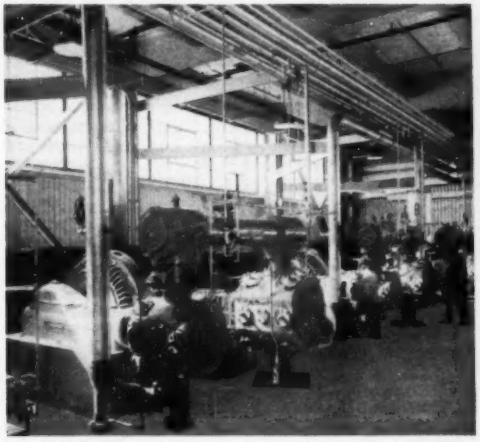
UP-TO-DATE POWER-PLANT EQUIPMENT . . .

Automatically primed, horizontal, split-case double-suction pumps supply the mill's entire water needs of about 14 million gallons a day. Water goes through a Clarafloculator and then through a primary water-treatment plant, photo, *top of facing page*. All makeup for the boilers goes to evaporators and then zeolite softeners, photo, FEEDWATER MAKEUP, *left*, before entering the boiler cycle. Well water acts as standby should river water get too bad for boilers.

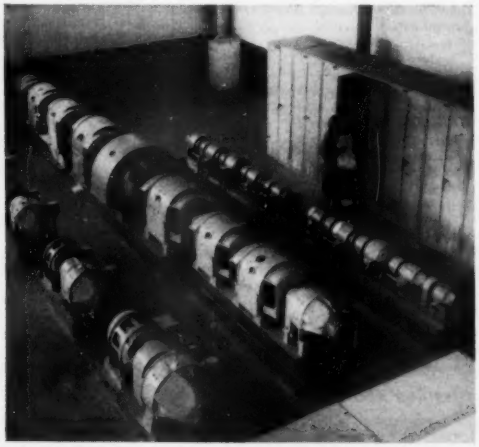
Circulating water for the turbine condensers and the



PRIMARY WATER TREATMENT, consisting of three pressure filters (left) and two zeolite softeners, handles water leaving the Clarafloculator. Plant uses as high as 14 million gallons daily of San Joaquin River water for both process and power



COMPRESSED AIR is important paper-mill production tool. Two-stage units supply 100-psi air, smaller ones give 200-psi supply



DIRECT-CURRENT electric energy serves throughout the mill. Middle row of m-g sets handles mill-board machine demands

. . . HIGH-PRESSURE STEAM BALANCED BETWEEN PROCESS AND POWER GIVES LEAST COST

generator air coolers goes to mill-supply water pumps or back to the Clarafloculator. A temperature-controlled unloading valve on a branch off the return line dumps this water back to the river if the temperature in the Clarafloculator gets above 85 F.

Extraction or bleed-condensing turbines, photo, POWER GENERATED, *facing page*, supply low-pressure steam at 50- and 25-psi automatically while the noncondensing unit exhausts to the 25-psi line and feeds 150-psi steam automatically. Steam-reducing stations connect in parallel to handle any mill requirement even under emergency conditions.

Electric-energy requirements include a fair amount of dc in addition to the usual ac. This form of electric current comes from a battery of motor-generator sets, photo, DIRECT CURRENT, *above*. Left row supplies general mill needs, middle row the mill-board machine only, right row amplidyne controls of mill-board unit. (*Continued on next page*)

PRINCIPAL POWER-PLANT EQUIPMENT

San Joaquin Div No. 7, Fibreboard Products Inc, East Antioch, Calif.

STEAM-GENERATING EQUIPMENT:

Boilers, 2 ..... Babcock & Wilcox Co
160,000 lb per hr, 650-psi design pressure, 725 F final temperature, 28,000 Btu per cu ft heat release, 15,183 sq ft heating surface, bare-tube waterwalls, tubular air preheater
Boiler refractory ..... Harbison-Walker Refractories Co
Insulating materials ..... Pabco Products, Inc
Soot blowers ..... Diamond Power Specialty Corp
Air-puff type, sequential automatic control
Burners ..... Coen Co.
Combination gas and mechanically atomized oil-steam
Regulators ..... Bailey Meter Co
Combustion controls ..... Bailey Meter Co
Forced-draft fans ..... Buffalo Forge Co
Double inlet, vane controlled, delivers 246,000 lb of air per hr at 11 in. wg with inlet air at 105 F
Induced-draft fans ..... Buffalo Forge Co
Double-inlet, louver controlled, develops 10 in. wg handling 279,000 lb of gas per hr at 395 F
Forced-draft fan drive, full capacity ..... Elliott Co
150-hp motor
Forced-draft fan drive, half speed ..... Westinghouse Elec Corp
25-hp motor
I-d fan drive, full capacity ..... Elliott Co
250-hp motor
I-d fan drive, half speed ..... Westinghouse Elec Corp
40-hp motor

BLACK-LIQUOR RECOVERY UNIT:

Recovery unit, 1 ..... Babcock & Wilcox Co
Integral furnace, cross-drum design develops 109,000 lb steam per hr at 575 psi, 700 F, burning 28,100 lb black liquor solids per hr on basis of a black liquor with 62% solids content entering the furnace and 50% solids entering the evaporator
Superheater, 1 ..... Babcock & Wilcox Co
Evaporator, black liquor ..... Babcock & Wilcox Co
Cyclone type
Burners ..... Babcock & Wilcox Co
Oscillating black-liquor and steam-atomizing-oil designs
Pumps ..... Worthington Pump & Machy Co
Green and black liquor
Refractories, hopper lining ..... Gladding, McBean & Co
Insulating materials ..... Pabco Products, Inc
Soot blowers ..... Diamond Power Specialty Co
Steam type and air puff with sequential automatic control
Forced-draft fan ..... Clarage Fan Co
Double inlet, discharge louver control, delivers 198,000 lb air per hr at 14.6 in. wg with 105 F entering air
Induced-draft fan ..... Clarage Fan Co
Double inlet, speed and discharge louver control. Develops 12.9 in. wg handling 275,000 lb gas per hr at 350 F
Forced-draft fan drive ..... General Electric Co
Steam turbine delivering 196 hp at 4440 rpm
I-d fan drive ..... General Electric Co
Steam turbine delivering 363 hp at 4482 rpm
Combustion controls ..... Bailey Meter Co

TURBINES AND AUXILIARIES:

Turbine-generators, 2 ..... General Electric Co
4000 kw, 3 phase, 60 cycle, 3600-rpm double automatic extraction condensing with direct-connected totally enclosed exciter. Initial bleed pressures 25 and 50 psig, condensing at 2 in. Hg
Turbine-generator, 1 ..... General Electric Co
4000 kw, 3 phase, 60 cycle, 3600 rpm single automatic extraction non-condensing turbine with direct-connected totally enclosed exciter, initial bleed pressure 150 psig
Condensers, 2 ..... Ingersoll-Rand Co
5500-sq-ft capacity to condense 42,000 lb of steam per hr at 2 in. Hg with 5000 gpm at 80 F
Turbine-oil purifiers, 3 ..... DeLaval Pacific Co
Centrifugal type with electric heaters and DeLaval-Funk process—20 gph processing, 75 gph purifying

WATER-TREATMENT EQUIPMENT:

Filters, 3 ..... Permutit Co
Pressure type with manually operated multiport valves
Softeners, 2 ..... Permutit Co
Sodium zeolite, automatically controlled valves
Heater, 1 ..... Permutit Co
Deaerating spray with acid-mixing chamber, 75,000 lb per hr capacity
Pumps, acid feed, centrifugal ..... Roth Pump Co
Pumps, caustic feed, reciprocating ..... Milton Roy Co.
Acid control ..... Leeds & Northrup Co
pH recording, controller with automatic control valve
Evaporators, 3 ..... Griscom Russell Co
32,500 lb per hr at 26 F temperature difference
Water treatment ..... Hall Laboratories, Inc

PUMPS AND HEATERS:

Deaerating heater ..... Elliott Co.
Direct contact, 300,000-lb-per-hr capacity, 75,000-lb storage
High-pressure heater ..... Foster Wheeler Corp
300,000 lb per hr at 150 psig, from 267 to 350 F
Condensate pumps, 4, single stage ..... Ingersoll-Rand Co
Condensate-pump drive, 1 ..... L J Wing Mfg Co
Turbine drive
Condensate-pump drive, 3 ..... General Electric Co
Motor drives
Boiler feed pumps, 3 ..... Ingersoll-Rand Co
Six-stage, integral oil coolers, Kingsbury thrust bearings
Boiler feed-pump driver, 2 ..... General Electric Co
Turbine drives
Boiler feed-pump drive, 1, motor ..... Elliott Co
Booster pumps, hotwell, 2 ..... Ingersoll-Rand Co
One turbine-driven ..... L J Wing Mfg Co
One motor-driven ..... General Electric Co
Circulating-water pumps, 3 ..... DeLaval Steam Turbine Co
One turbine-driven ..... General Electric Co
Two motor-driven ..... General Electric Co
Service-water pumps, 2 ..... DeLaval Steam Turbine Co
One turbine-driven ..... L J Wing Mfg Co
One motor-driven ..... General Electric Co
Makeup booster pumps, 2 ..... DeLaval Steam Turbine Co
One turbine-driven ..... L J Wing Mfg Co
One motor-driven ..... General Electric Co
Cooling-water pumps, 2 ..... DeLaval Steam Turbine Co
One turbine-driven ..... L J Wing Mfg Co
One motor-driven ..... General Electric Co

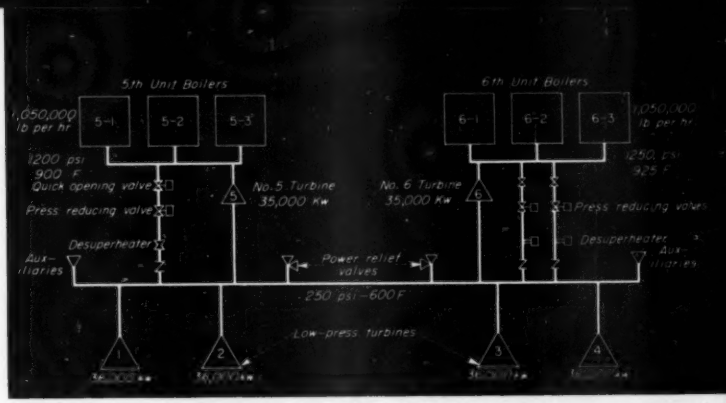
VALVES AND PIPING:

Safety valves ..... (Consolidated) Manning, Maxwell & Moore, Inc
Relief valves ..... Atwood & Morrill Co.
Turbine bleed, exhaust, reducing stations
Relief valves, small ..... Chas M Bailey Co
Reducing stations ..... Bailey Meter Co
One 575 to 150 psig, one 575 to 50, one 575 to 25
Desuperheaters ..... Bailey Meter Co
Spray type for reducing-station service
High-pressure valves ..... Chapman Valve Mfg Co
Flanged gate, globe and check
High-pressure valves ..... (Hancock) Manning, Maxwell & Moore, Inc
Screwed gate, globe
Low-pressure valves: Flanged gate, globe and check ..... Walworth Co / Crane Co
Low-pressure valves ..... Lunkenheimer Co
Screwed gate, globe and check

POWERHOUSE AUXILIARIES:

Compressors, 3 ..... Ingersoll-Rand Co
V-belt driven, 2-stage double-acting with intercoolers, 147-cfm capacity at 350 psig for soot blowers
Compressor drives, electric motors ..... General Electric Co
Crane, 1 ..... Harnischfeger Corp
30 ton, 46-ft span, fully motorized
Bearing and jacket-water cooler, 2 ..... Ross Heater & Mfg Co
Shell and straight tube, floating-head design
Fuel-oil heaters, 2 ..... Coen Co
Shell and straight tube
Fuel-oil pumps, 2 ..... DeLaval Steam Turbine Co
Positive-displacement type
Oil-pump drive, 1, turbine unit ..... L J Wing Mfg Co
Oil-pump drive, 1, motor ..... General Electric Co
Controls ..... Industrial Div, Minneapolis Honeywell Reg Co
Pressure and temperature gages, panel and wall ..... Ashcroft / Industrial thermometers ..... American / Manning, Maxwell & Moore, Inc
Draft and pressure gages, multipoint ..... Hays Corp
Recorders, CO_2, 2 ..... Leeds & Northrup Co
Electric type, continuous recording
Temperature recorders ..... Brown Instrument Co
Air and gas, boiler multirecord pyrometers
Meters, steam and water ..... Bailey Meter Co
Recording mechanical-type, flow, temperature-pressure

Keeping 1,000,000 lb per hr of steam flow in harness when it suddenly has no place to go is quite a trick. Add to this job that it must just as quickly be throttled and desuperheated and you have a chore that no man can do fast. That's where. . . . .



1 West End Station is a completely topped plant, with no l-p boilers to back up loss of topping-exhaust steam. Steam bypasses topper to l-p header in emergency

. . . Automatic Bypass Controls Pay Off

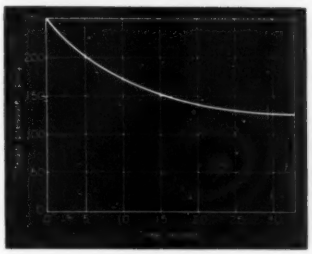
By **B. J. YEAGER**, *Mechanical Engineer*
The Cincinnati Gas & Electric Co

► ACCIDENTAL TRIPPING of the main circuit breaker of a 35,000-kw topping unit caused it to drop 40,000-kw load on Sept 30, 1949. West End Station's Unit No. 6 was taking 1,000,000 lb per hr of 1250-psig 925-F steam at the time. Automatically controlled bypass valves and desuperheaters immediately diverted this steam to the low-pressure header. Steam conditions were dropped to 250 psig and 625 F. This transfer caused minimum disturbance to the boiler plant. The operators were completely satisfied with the response of the equipment.

Fig. 1 shows the station arrangement to be a completely topped plant. The boilers burn pulverized coal. The three boilers serving each unit develop total output ranging from 105,000 to 115,000 kw. When a topping turbine trips out, automatic bypasses reduce load loss to that dropped by the high-pressure unit. Bypasses include reducing valves, desuperheaters and control equipment. Transferring h-p steam to the l-p header allows the l-p turbines to continue running at rated load when the topper is out.

Bypass Controls. Because of separate h-p headers for each topper, the control equipment must cut in only the bypass for the topping unit that trips out. The governor-control oil pressure on each topping turbine causes this selective action. In addition, No. 6 unit has a control to trip one of its reducing valves in the event of low steam pressure in the l-p header. Either one of the two valves may be used by preselection with a transfer valve.

The two pressure-reducing valves on No. 6 are each rated at 525,000 lb per hr when reducing steam from 1250-psig and 925-F to 250-psig and 600-F. This flow has been set by adjusting stops on the valves. Valve travel at this flow is one inch. Pneumatic controls supervise the oil-operated valves. A dual set of pumps, developing 150 psig constantly, maintain oil pressure. The plant main air-control system supplies air at 100 psig and 5 psig.



2 Main pressure drops rapidly when full load topping exhaust is cut in half

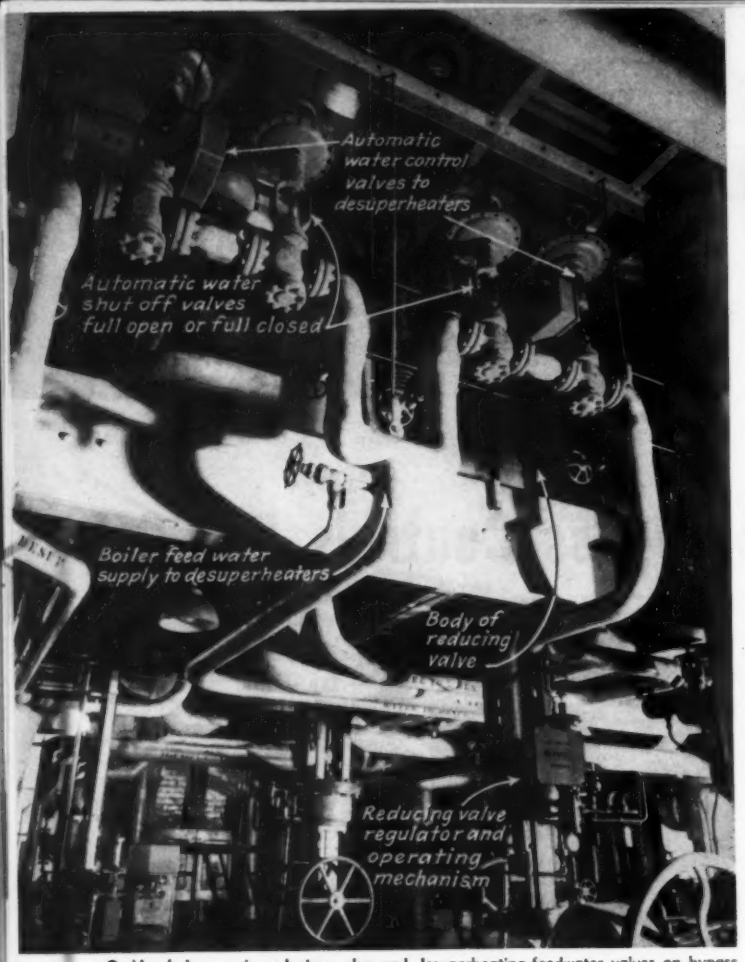
Bypass valves open to full flow after initial impulse at the turbine control panel in total elapsed time of 7 seconds. This was believed fast enough to maintain reasonable pressure in the l-p header when a topper tripped out. The reducing station is adjusted to cut into service when the topping-turbine load drops to about 1000 to 2000 kw.

If the valves fail to open from faulty control, the l-p regulator trip opens one valve at a pressure of 235 psig. The power relief valves on the l-p header are set for a 275-psig electrical trip and 290-psig mechanical trip. Temperature-sensitive controls are set for adding enough boiler feedwater, with steam atomization, to maintain 600-F steam temperature. At temperature reduction from 925 to 600 F, outlet l-p steam flow equals roughly 113% of h-p steam flow.

Bypass Operation. No. 6 unit's reducing station went into service in July 1948. It has been used many times for steam control during scheduled turbine outages and was also used for several months before the topper went into service. Valves and desuperheater performed nicely with only minor control adjustments needed. During topper shutdown operations, the reducing station was usually controlled manually to closely coordinate turbine load decrease and valve steam-flow increase. This way, the operators maintained practically stable conditions in the boiler plant.

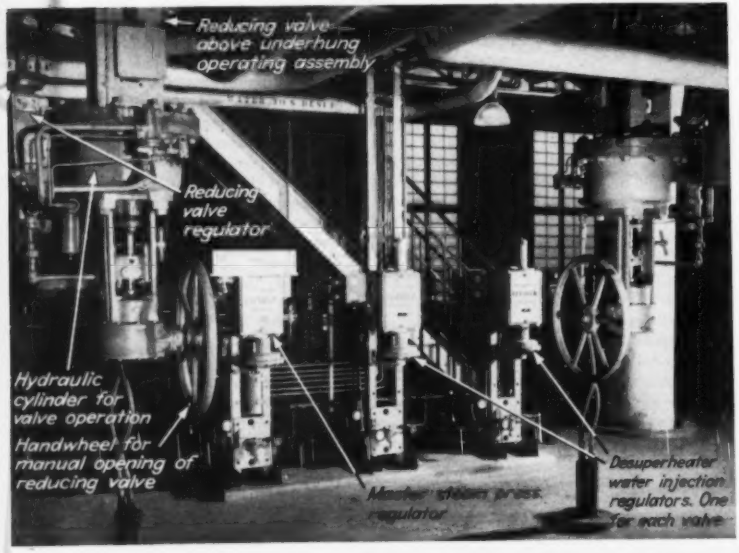
At about 12:40 pm on Sept 30, 1949, the station had its first emergency test of steam transfer through the reducing-valve bypass. An electrician working on the turbine-generator benchboard in the electric-control room accidentally tripped out the main circuit breaker on No. 6 generator. The reducing station responded immediately as the turbine's steam control valves closed. These valves close in 1 to 1½ seconds, quick enough to keep the relatively light rotor from tripping out on overspeed. The speed-recording chart indicated a maximum turbine speed of 3900 rpm, lower than the overspeed trip setting.

Station load at time of tripout was

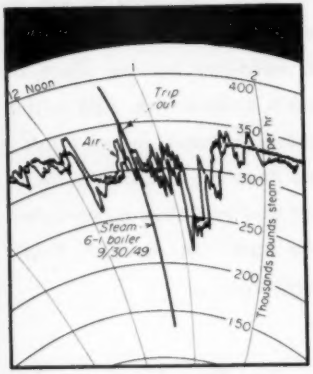

Automatic water control valves to desuperheaters
Automatic water shut off valves full open or full closed
Boiler feed water supply to desuperheaters
Body of reducing valve
Reducing valve regulator and operating mechanism

3 Here's how main reducing valve and desuperheating-feedwater valves on bypass around No. 6 topping turbine are arranged in the basement of West End Station

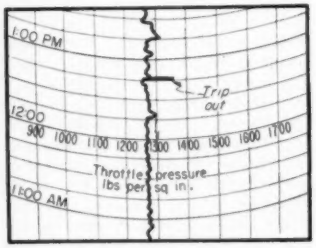
4 Heart of bypass automatic-control system stands in master steam-pressure regulator at left. It acts on regulators controlling reducing and water valves


Reducing valve above underhung operating assembly
Reducing valve regulator
Hydraulic cylinder for valve operation
Handwheel for manual opening of reducing valve
Desuperheater water injection regulators. One for each valve

INSTRUMENT RECORDS TELL



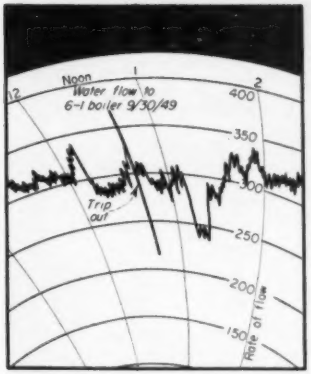
5 Boiler steam flow drops on tripout, surges up as bypass opens in 7 sec



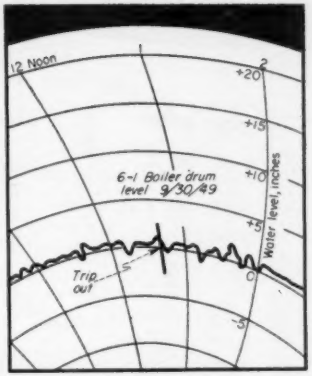
9 Throttle pressure rose until bypass to I-p header opened automatically

160,000 kw. The 40,000-kw loss on No. 6 dropped station load to 120,000 kw with about the same steam flow demand as before tripout. Since this operation took place in less than 7 seconds, and no high-speed recording instruments were available, an actual picture of transient conditions during steam transfer cannot be reconstructed. Fig. 5, 6 and 7 are representative chart records of one of the three boilers, each unit generating about one third the total rate. Fig. 5 shows the steam flow at tripout to be 340,000 lb per hr. Steam flow fluctuated between 135,000 and 395,000 lb per hr. Not much is known about the speed of response of the flowmeters, but it can be surmised that the flow dropped as the turbine control valves slammed shut.

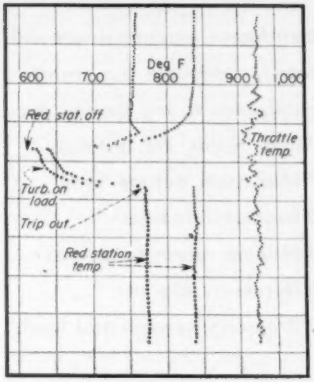
As the reducing valves opened to take steam, they apparently overshot, which might account for the high flow. These flows had to change rapidly because it is known by test that the reducing valves open fully in 7 seconds. Fig. 6 shows feedwater flow under 3-



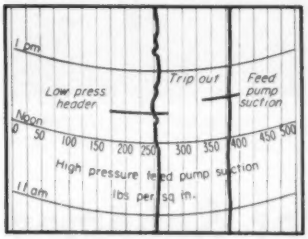
6 Feedwater flow behaves like steam flow, but with less wide swinging



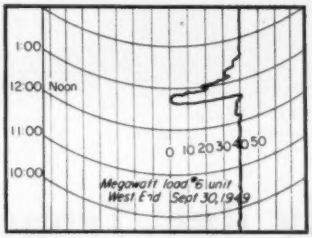
7 Boiler drum levels were only slightly affected, lessened feedwater surge



8 Steam temperatures at h-p main and reducing stations behaved smoothly



10 Pressures of l-p steam main and boiler feed-pump suction surged too



11 No. 6 dropped 40,000 kw on trip-out, was reloaded fully in one hour

element control has the same pattern as steam flow. Fig. 7 shows a slight disturbance in drum level.

Fig. 9 records an increase in steam pressure in the h-p header from 1275 to 1350 psig. This shows the transfer was completed quickly without opening the relief valves on the boilers. Fig. 10 indicates that the l-p header pressure dropped to 160 psig. We don't know whether the pressure actually dropped that low, or whether part may have been due to rapid swing and overtravel of the chart pen.

When the valves overshot, steam pressure reached 275 psig. This is about correct because the operators verify the opening of one power relief valve for just an instant. The valve opening cannot be mistaken because its noise is heard for several miles. Pressure drop in the the l-p header must have been of extremely short duration since no difficulty was experienced with the steam-driven boiler feed pump or vacuum-jet equipment. A sustained pressure reduction to 200 psig in the 1-p header causes serious operating difficulty.

Equipment Arrangement. Fig. 2 gives the calculated pressure loss in the l-p header when a topper trips out and cuts off half the steam flow at full load conditions. Steam can be taken only from piping storage itself, which is very small. The graph shows that this pressure can drop to 130 psig in about 3 sec. Hence, the reducing valve must open quickly when needed.

Fig. 4 shows the reducing valve and control regulators. In the foreground are the hydraulic operators with hand-wheels. Regulator for operating the valve mounts on the side of the oil piston casing. Three regulators in background are master steam-pressure regulator, *left*, with two steam temperature regulators, *on the right*.

Fig. 3 shows bottom of reducing valves in lower background. Automatic shut-off and regulating water valves for temperature control hang in upper foreground. Top of main reducing valve can be barely seen above girder across the middle.

Essential equipment for operating one reducing valve includes:

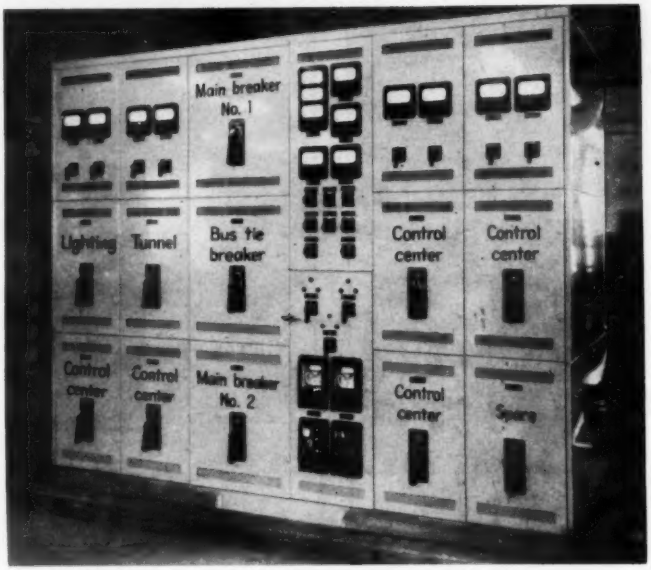
1. Reducing-valve regulator for operating oil pilot valve on hydraulic valve operator.
2. Air relay mounted on valve for opening diaphragm shutoff valves on steam-atomizing and water-injection lines when reducing valve begins to open.
3. Governor oil-air pressure converter.
4. Oil-pressure mercoid-actuated solenoid-operated positioning relay for blocking control air pressures when reducing valve is closed.
5. Steam-pressure master regulator with dual head and air relay sender for control air loading during shutdown and operation.
6. Steam-pressure trip regulator for opening one reducing valve in event of low steam pressure.
7. Subpanel for transfer from automatic to manual operation of reducing valve.
8. Diaphragm-operated shutoff valve for water supply to desuperheater.
9. Diaphragm-operated shutoff valve for steam supply to atomizer.
10. Diaphragm-operated regulating valve for controlling water injection.
11. Bimetallic-operated air-pressure sender for temperature detection to actuate temperature regulator.
12. Steam temperature regulator for controlling water-regulating valve.
13. Subpanel for transfer from automatic to manual operation of water injection to the desuperheater.

BUS TIE OR TRANSFER BREAKER AUTOMATICALLY CONNECTS...

Switchgear manufacturers will supply adequate bus transfer equipment if you specify particular needs. For instance:

1 Maximum outage time
2 Lockout if tie trips
3 Manual return to normal
4 Necessary alarms
5 Dropping nonessential loads

By AMADO CONANGLA
Electrical Engineer
I-T-E Circuit Breaker Co



EITHER SOURCE may be selected as normal at operator's discretion. Provide for dropping all nonessential loads if their inclusion would overload standby source

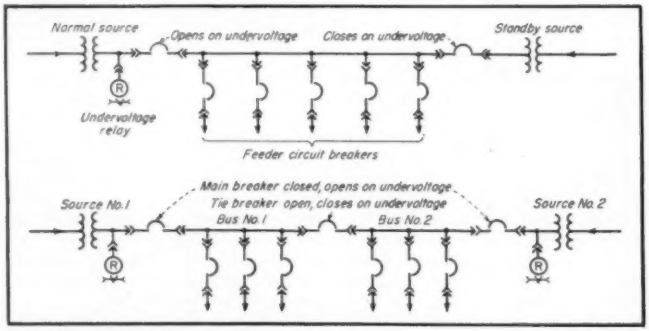
How to Specify Bus-Transfer Schemes

► ONE METHOD generally adopted for improving bus reliability is to provide two sources of supply and a means for switching the bus from one to the other. Additional supply source may be just a separate stepdown transformer fed from the same incoming line. Or it may be a separate line or a local generator. Air circuit breakers may be used to disconnect bus from dead source and connect it to standby source.

Automatic Transfer. If breakers are manually controlled, considerable time may elapse before an operator becomes aware of the power outage. Hence, the delay in necessary switching to restore service. Outage time can be shortened if breakers are controlled electrically from an attended location. Then use alarms to indicate source-voltage failure.

Duration of power outages can be reduced to minimum by automatic switching in response to voltage conditions. This type of control is often specified for main and tie breakers in switchgear equipments and unit substations.

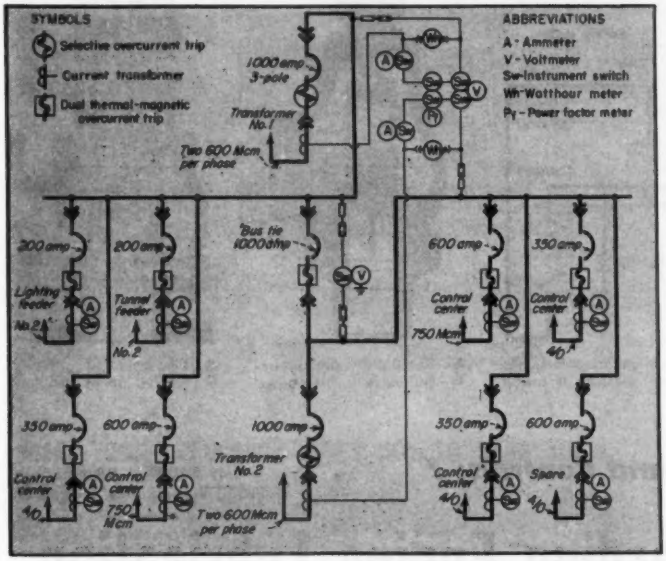
Main function of an automatic bus-transfer scheme is to open normal source breaker and close standby source breaker on failure of normal source voltage. But a scheme arranged to perform just this and nothing else is likely to prove unsatisfactory. It may be desirable, for instance, to prevent the transfer if the low bus-voltage condition is due to a fault. Or to retransfer automatically when main source is reenergized. Then there is need for a subsidiary operation like sounding alarms when a transfer is completed.



IMPROVED RELIABILITY stems from providing two power sources for plant bus. Standby source may be separate feeder or a tie-in with the local generating equipment

Proper Approach. Satisfactory trans-

...STANDBY POWER SOURCE TO BUS IF NORMAL SOURCE FAILS



SPECIFY INTERLOCKS to prevent paralleling the two sources. If necessary, manual or automatic features may be selected by operator from switch on control board

fer scheme starts with a clear and detailed specification of exactly what the scheme will be required to accomplish under different conditions. To prepare such a specification, consider nature of service and conditions likely to be met during operation. For instance, if standby source has a reduced capacity, it may be advisable to drop nonessential loads automatically after a transfer occurs.

Switchgear manufacturers will design and build transfer schemes arranged to perform the automatic operations stipulated by purchaser. But, in general, they will not include functions not mentioned by the purchaser, unless obviously necessary. It may take some time after switchgear equipment is in operation to realize the scheme fails to perform a desirable function, or that it performs an undesirable operation.

Although it is usually possible to revamp in the field, it is costly and may require a complete shutdown. So a thorough study of requirements should precede preparation of specifications. Here is a check list of requirements to consider in a specification.

Loss of Normal Voltage. Automatic transfer upon loss of normal-source voltage is the basic requirement. Loss of normal voltage over a prescribed interval causes disconnection of bus from this source, and connection to standby source. This requirement is generally met by a time-delay voltage relay to start breaker tripping and closing operations.

Instantaneous voltage relays are generally not adequate. They would result in transfers upon momentary voltage dips caused by feeder faults or by starting some large motor. Time-delay voltage relay permits "riding" over these dips, and allows an interval to permit discrimination between failure of source voltage and low bus voltage due to a fault. Permissible outage duration should be specified after considering spoilage of material being processed, motor inrush currents upon reenergizing after slowdown, etc.

Undervoltage Trip. In a transfer scheme designed to respond only to voltage, transfers may result from low voltage due to a fault. It is important to specify whether automatic transfer under this condition is desired.

It is possible to prevent transfer and lockout breakers until reset by hand. Or you can arrange for a one-shot reclosure from either main or standby source side, followed by lockout if the reclosure results in a new overcurrent trip. In any case provide for this in the specifications.

Return of Normal Voltage. Retransfer upon return of normal-source voltage may be arranged. Hence restoration of this voltage after an automatic bus transfer causes another automatic transfer back to normal source. It may be desirable, however, to arrange the scheme so manual operation will be needed to switch back.

Manual or Automatic. Because of unforeseen conditions that may arise it is sometimes desirable to defeat all or some automatic features at the operator's will. Provision can and should be added to the scheme to permit selecting manual or automatic operation by simply turning a control-switch handle. To allow flexibility it may be desirable to establish at the operator's will which one of the two sources is to act as normal or preferred source. The scheme can be arranged to permit this selection. Alarms can be provided to indicate that a transfer has been completed, or prevented because of an overcurrent trip, etc.

Interlock. Interlock to prevent paralleling the two sources. When they are not in synchronism, or when their combined short-circuit capacity is excessive, it may be necessary to provide interlocks to prevent paralleling during transfer or retransfer.

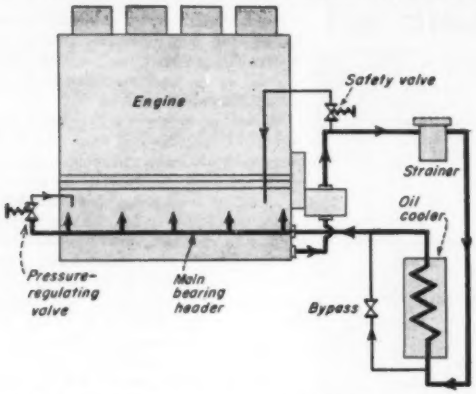
Drop nonessential load upon transfer if it imposes an overload on standby source. Nonessential services can be sacrificed to maintain a supply to essential services.

Then coordinate transfer and selective tripping. With this tripping, a fault must be cleared by the nearest breaker. And tripping of successive breakers between fault and source is purposely delayed to allow just this. Since an undervoltage will appear at bus for fault duration, transfer should be prevented under these conditions for a prescribed time.

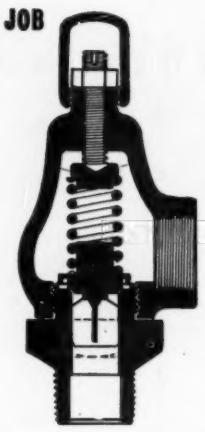
Control Power. Specify whether an independent source of control power, such as a station battery, is available. When control power must be drawn from same sources as those controlled by transfer scheme, availability of that control power will be affected by same conditions that would cause a transfer. And since a transfer cannot be effected unless control power is available, the scheme must include means for transferring connections to control bus as well as main bus.

Summary. First carefully consider all the above requirements. Then decide which ones are desirable for your particular installation. Prepare a brief description of operation indicating how equipment must operate in response to different conditions. Include this description in the specification. It will permit equipment manufacturers to design and manufacture apparatus that will give you the maximum benefits per dollar spent.

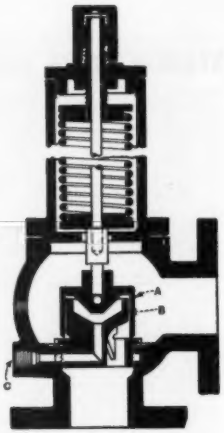
HOLDING NEEDED LUBE PRESSURE IS PRIMARY JOB



1 To assure needed pressure at all lubrication points, the pressure-regulating valve is put where pressure is lowest



2 Single-disk pressure-relief valve is often used



3 Pilot-operated valve is hooked up as in Fig. 5

Diesel Instruments and Controls: 7

By EDGAR J KATES
Consulting Engineer, New York, N. Y.

Tips on Guarding Engine Lubrication

The right devices, in the right places, take the "guess" out of diesel lubrication, insure the dependable operation you want. Here's a practical guide to what you need for this vital job

► DEPENDABLE LUBRICATION is so important in diesel operation that the engine builder frequently furnishes controls and safeguards for the lube system. Nevertheless, it's worthwhile to take a look at what's needed because (1) systems of old engines can often be improved by modernization, and (2) not all new engines come completely equipped with lube-system controls.

Lubrication Job. A prime reason for lubrication is, of course, to reduce friction and wear. Along with this goes the job of carrying away heat from rubbing surfaces—pistons, rings, bearings, valve stems, cams, etc. Some of this heat comes from friction, some from combustion in the cylinders. Higher specific outputs of modern engines put more heat load on pistons; hence they frequently need direct piston-head cooling. Up to medium engine sizes, this can usually be handled by oil from the bearing-oil system; in larger engines, an entirely separate lube-oil circulating and cooling system is used.

Engine size makes another difference in lubricating systems. In small units, "throw-off" from crank bearings may be counted on to give enough lubrication to cylinder walls. Medium- and large-size engines have independent force-feed lubricators to deliver oil directly to most favorable spots on cylinder walls. Forced feed may be timed in synchronism with motion of the piston.

Pressure Control. Holding needed pressure is primary control job in a lube-oil circulating system. Pressure delivers oil to bearings and through bearing clearances, and also through lubricating orifices at gears, etc. It is standard practice to use an oil-circulating pump having excess capacity. Oil that cannot find its way through bearing clearances and other orifices discharges from the pressure system through a relief valve. To assure needed pressure at all lubricating points, pressure-regulating valve is at point where pressure is likely to be lowest, or is controlled by pressure at that point, Fig. 1.

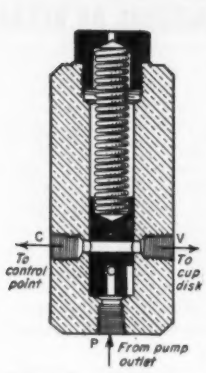
Relief Valves. Conventional single-disk pressure-relief valves, Fig. 2, find common use on small engines. Such valves may chatter when partly open because effective pressure on disk decreases when flow begins. Valve doesn't hold uniform pressure because operating pressure varies both with oil temperature and with rate of flow.

For one thing, system pressure drops as oil heats up, because valve capacity increases as oil becomes less viscous. This is not usually too serious, however, as a warm engine needs less oil pressure to supply enough oil to all lubricating points.

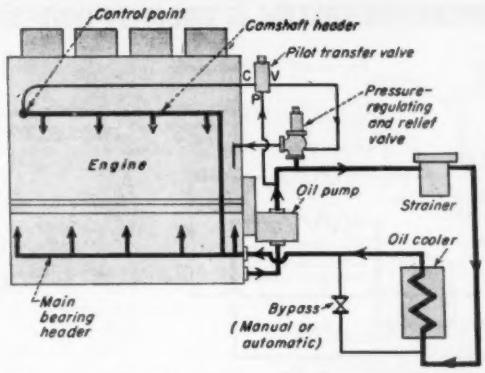
For another thing, system pressure drops as bearings wear and more oil squeezes through bearing clearances. Relief valve then has less oil to discharge, hence pressure falls. But this reduced pressure is actually beneficial in many engines that depend on bearing throw-off for cylinder lubrication. Full pressure would throw still more oil onto cylinder walls and increase amount of oil lost into the combustion chamber. As long as pressure stays high enough to deliver all oil the bearings can take, they will be adequately lubricated.

Safety Valve. With pressure-relief valve at far end of system (or controlled by pressure at that point), starting with cold oil may cause excessive pressure at pump outlet before there is enough

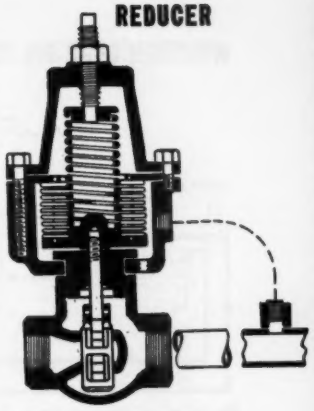
PILOT-OPERATED VALVE HOLDS PRESSURE, ACTS AS SAFETY REDUCER



4 Transfer unit for pilot-operated valve of Fig. 3

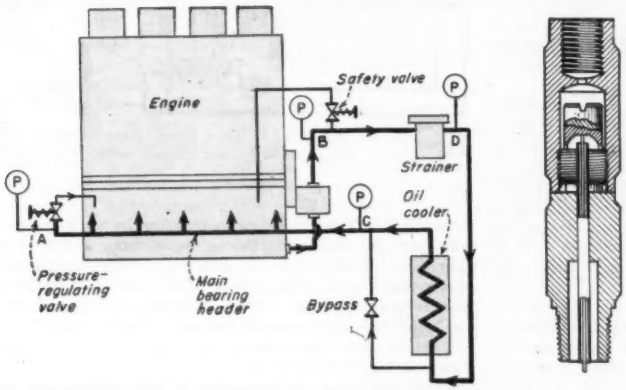


5 Connected as shown, pilot-operated valve serves for pressure regulation and acts as safety valve, protecting pump



6 Rocker-arm lube oil may require lower pressure

WHERE TO USE PRESSURE GAGES, HOW TO 'SNUB' THEM



7 If only one gage is installed, put it at *A*. Second gage at *B* checks pump operation. Additional gages at C and *D* show pressure drop in strainer and cooler

8 Pressure-gage snubber (*right*) has piston whose rise and fall absorbs shock and surge in gage line. This action gets rid of dirt, makes device self-cleaning

pressure at far end to open pressure-relief valve. To protect pump, a safety valve is often installed at pump outlet.

Combined Relief and Safety. An interesting device, Fig. 3, combines functions of a pressure-regulating valve and safety valve. This pilot-operated design is particularly adapted to larger engines because it eliminates expensive and bulky separate relief valve and greatly reduces amount of large piping. The protection should prove more dependable than a rarely operated safety valve.

Valve disk *A* is in form of a cup. It slides on guide *B*. Oil pressure introduced at pilot connection *C* works against underside of cup disk and opens valve when pilot pressure overcomes spring pressure.

Fig. 4 shows construction of the pilot-transfer valve, which operates the main valve. Connection to control point is at *C*, while *V* connects to cup disk of main valve and *P* runs to the pump outlet. Fig. 5 shows piping arrangements on engine.

How It Works. In normal operation, piston of pilot-transfer valve rests in bottom position, as shown in Fig. 4. Oil pressure at control point is transmitted to cup disk of main valve, causing it to regulate pressure in engine system by discharging surplus oil. Safety-valve action occurs if pump pressure becomes excessive when starting with chilled oil. Pump pressure lifts pilot-transfer-valve piston, connects ports *P* and *V*, and causes pump pressure to lift disk of main valve.

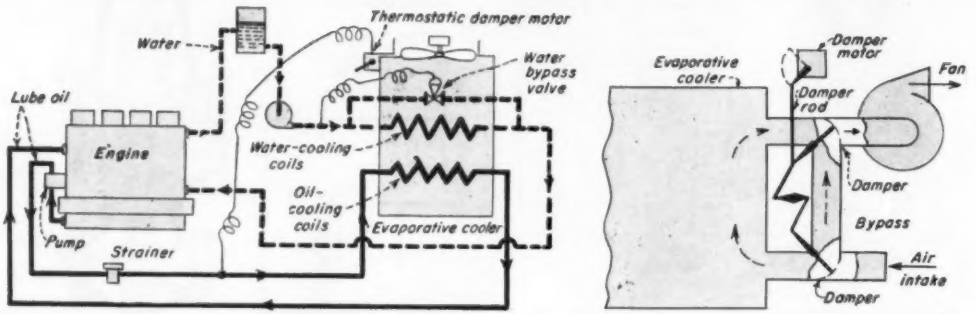
Bypassing Oil Cooler. Oil coolers are frequently hooked up with either a manual or automatic bypass. Bypass should be open during starting, until oil reaches normal running temperature. This insures full pressure at engine and warms oil rapidly. Note that oil bypassed around oil cooler, Fig. 5, goes to engine oiling system, but oil discharged from safety valve goes direct to the crankcase sump.

Automatic control of bypass relies on fact that when oil is cold its high viscosity increases the pressure drop through the oil cooler. Pressure-relief valve is connected between inlet and outlet of cooler and adjusted to open when pressure exceeds normal drop across cooler. Note that pressure-relief valve also opens if oil cooler clogs, and thus keeps pressure on engine oiling system. If so much oil is bypassed around cooler that oil entering engine is too warm, thermometer at engine inlet will show this.

Rocker Lubrication. For some engines it is desirable to supply lube oil to rocker arms, etc, at lower pressure (say, 15 to 20 psi) than the main system (say, 60 to 80 psi). Fig. 6 shows design of a pressure-reducing valve for this purpose. Features are: (1) long spring to minimize pressure variation when the valve opens and closes (2) compact metal bellows to operate valve, and (3) balanced ported slide valve for minimum resistance to movement.

(*More on next page*)

WHETHER LUBE-OIL-TEMPERATURE CONTROL IS DIRECT OR INDIRECT DEPENDS ON NEEDS



9 When evaporative cooler has oil-cooling coils, lube temperature may be controlled by operation of dampers on the evaporative cooler. This is done automatically from thermostat in the oil line from engine. Diagram shows hookup

Pressure Indication. At least one pressure gage is needed on each engine to show if oil pressure is high enough. If only one gage is installed, connect it at far end of system, as at *A*, Fig. 7. If this gage shows normal pressure, it proves that even most remote point on the system is getting oil at sufficient pressure. This would not be indicated at gages at oil pump or entrance to engine, as pressure could be lost on the way by leaks or excessive pressure drops.

A second pressure gage is often connected to circulating-pump outlet, *B* in Fig. 7. This shows whether pump is working and whether backpressure on it is excessive. It also serves to check opening pressure of the safety valve.

A third pressure gage, at entrance to engine, *C* in Fig. 7, serves a useful purpose. If pressure at *C* is abnormally higher than at *A*, the unusual pressure drop points to a clogged engine system, worn bearings, or leaks. If pressure at *C* is abnormally lower than at *B*, look for clogging in strainer or cooler.

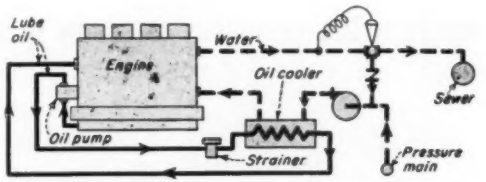
By installing a fourth gage between oil strainer and cooler, *D* in Fig. 7, pressure drop across each device is indicated. This is particularly useful for telling when the oil strainer (or filter) needs cleaning, and when the cooler should be bypassed.

Gage Snubbers. If delivery of oil-circulating pump pulsates, fit pressure gages with snubbers. Typical snubber is shown in Fig. 8. Such a device usually proves better than a small orifice or a "cracked" valve, because motion of piston avoids clogging tendency of small openings.

Pressure gages mounted on engines are sometimes subject to considerable vibration and are thus often mounted on a separate panel. If engine-mounted, important gages may be installed in duplicate. Since both gages are unlikely to fail at the same time, gage readings can be relied on if they are identical.

Temperature Control. Formerly, when engine ratings were lower, no oil coolers were used on small engines and no effort was made to control oil temperature. Natural radiation usually proved enough to keep oil at reasonable temperatures. This system warms oil slowly during startup, another disadvantage.

Modern design calls for oil-cooled pistons, and hence oil coolers become more or less standard equipment. Use of an oil cooler facilitates temperature control. On small engines, direct control isn't attempted. Rather, indirect control results from cooling the oil cooler with incoming jacket water, which is under thermostatic control in a bypass system, Fig. 10. When engine starts, jacket water warms rapidly and *heats* lubricating oil quickly to working temperature. After engine settles down to normal operating temperature, this hookup tends to keep lube oil at fairly constant temperature regardless of load because blended water *entering* oil cooler becomes cooler as load increases. Thus increased heating of lube oil at higher loads is offset, more or less, by greater heat transfer in oil cooler.



10 Indirect control results from using jacket water to cool the oil. Thermostatic bypass controls water temperature

Direct control of oil temperature is used (particularly on larger engines) if indirect control isn't deemed adequate or if oil is cooled by raw water instead of jacket water. Direct control may be obtained in several ways. One is to bypass the *oil* around the oil cooler as already mentioned. Another is to bypass the *water* around the oil cooler (see previous articles of this series: POWER, Nov 1950, p 92, Fig. 9; and Jan 1951, p 98, Fig. 11).

A third way, sometimes used with evaporative coolers containing oil-cooling coils as well as watercooling coils, is to control oil temperature by operating air dampers on the evaporative cooler. This is done automatically from a thermostat in the oil line from the engine. This scheme keeps oil temperature correct, independent of water temperature. Water temperature can be controlled simultaneously by an automatic bypass around the watercooling coils. This is actuated by a thermostat in the water line from the engine. Fig. 9 shows layout.

When engine starts, dampers shut off air supply to evaporative cooler, causing both oil and water to warm rapidly to working temperatures. In normal operation, dampers open enough to keep oil coming from engine at normal temperature; if this tends to overcool jacket water, thermostat in water line opens bypass valve around water coils.

Temperature Indication. Extent of temperature indication used varies greatly with size of engine and type of lube-oil system. Small engines having no "external" system are seldom provided with an oil thermometer because no control is available.

Where oil coolers are used, two thermometers prove useful—one in the oil line entering the engine (to show that cooler is doing its job) and the other in the line leaving the engine (to warn of overheating in engine). On large engines with independently cooled pistons, thermometers also show temperature of oil leaving pistons, either for the engine as a whole or for each piston.

Oil Quantity Control. Direct control of amount of oil supplied to the engine occurs in cylinder lubrication of larger engines where force-feed lubricators are used. Such devices always have some means for controlling quantity and usually also have indicators to show rate of oil delivery. In such case, user need install no additional controls or indicators.

Viscosity Indicators. Engines are occasionally fitted with devices to indicate viscosity of lube oil in the circulating system. These are particularly valuable where there is likelihood of lube oil being diluted with fuel oil. A typical *viscosimeter* is shown in Fig. 11. Oil from pressure line enters at left, passes through a filter screen. Unloading valve reduces its pressure to a constant level. Oil then flows through a calibrated orifice into a divided chamber. One branch connects with a calibrated capillary resistance tube. Opposite branch connects to indicating gage. Since resistance in capillary tube decreases with oil's viscosity, low gage reading reveals low viscosity.

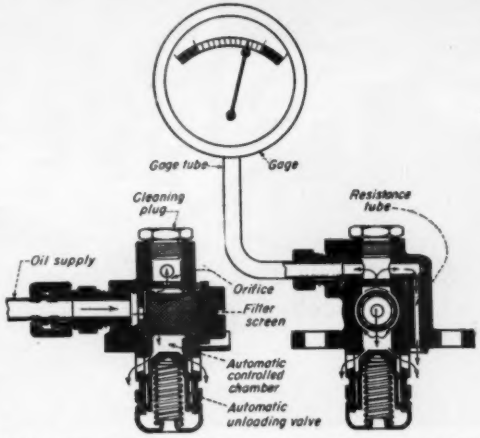
Filters, Strainers. Full-flow filters and strainers, which are installed in the main lube-oil circulating line, must be provided with pressure-relief valves to bypass them when backpressure gets excessive. This may result from too-cold oil or clogging in filter or strainer. Pressure gages at entrance and exit indicate pressure drop, showing whether device is working and whether cleaning is required.

Partial-flow or *bypass* filters, which filter only a small part of the oil circulated, are generally supplied from the oil-pressure system and discharge into the crankcase or sump. A valve at filter inlet permits cleaning and regulates rate of flow. Clean-oil line from filter should have a sightglass, bull's-eye or funnel to show the rate of flow and the cleanliness of the lubricating oil.

Keeping Oil Hot. Many filters work better when oil is hot. But bypass filters, for convenience, often stand at some distance from engine. Although oil is hot when it leaves engine, it cools rapidly on the way to the filter because flow rate is low and pipe has large heat-transfer surface. This cooling effect can be greatly reduced by arranging a circulating system between engine and bypass filter, Fig. 12. In this scheme, a portion of main flow is taken off before the oil cooler, circulates through the bypass filter casing and back to the outlet side of the oil cooler. Pressure drop in oil cooler causes flow in circulating piping. If you choose pipe sizes carefully, loss of cooling effect in oil cooler is negligible.

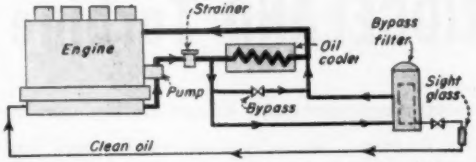
Centrifugal purifiers also need hot oil for best performance. A unique heater using engine exhaust and capable of heating 150 gph of oil to 175 F is shown in Fig. 13. Heater consists of a head through which exhaust gas enters at center and leaves in an annular ring, and three cylindrical elements: casing, heat exchanger and movable baffle. Heat exchanger is a cast element with external grooved oil passages and internal fins. Within it is a cylindrical baffle with a top collar, which acts as a control valve for exhaust gas. As shown at *A*, control rod is up and exhaust gas circulates through heat exchanger. In *B*, control rod is down, heater is shut off, and exhaust gas bypasses through head. Entire unit is easily cleaned, an operating advantage of practical importance.

VISCOSITY INDICATOR CHECKS DILUTION

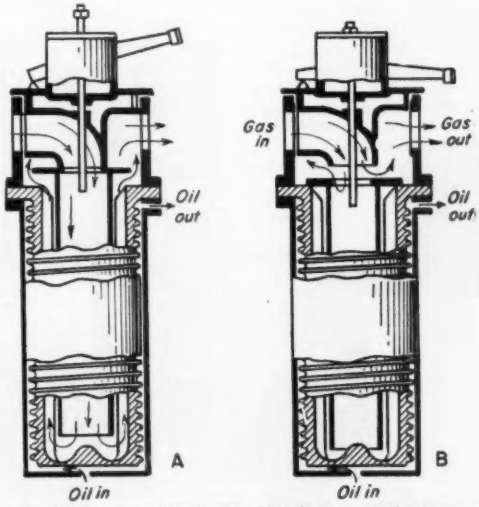


11 Gage on viscosity indicator shows resistance to oil flow in calibrated capillary tube. Low reading means low "vis"

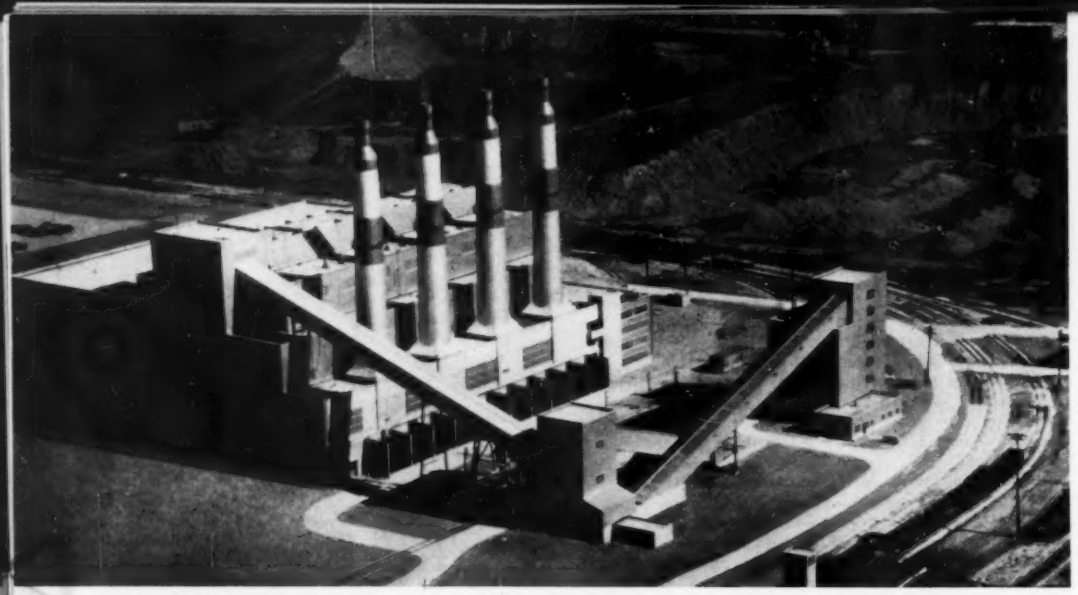
TWO WAYS TO KEEP OIL HOT FOR FILTERING



12 Circulating system reduces heat loss in piping between engine and bypass filter, holds lube-oil temperature up



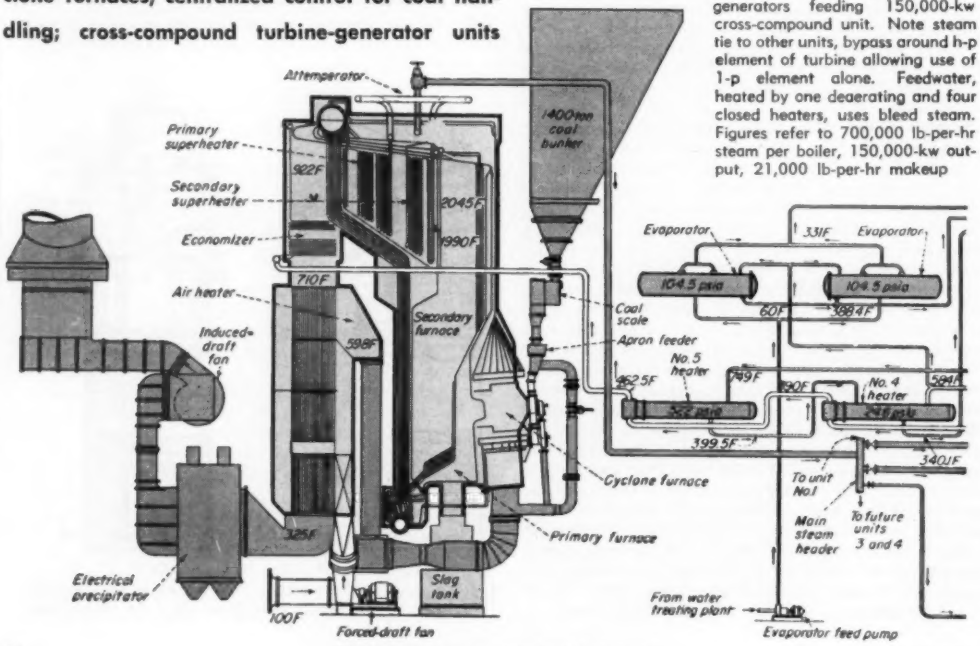
13 Using exhaust for heating, this device can raise temperature of 150 gph of lube oil to 175 F for centrifuging



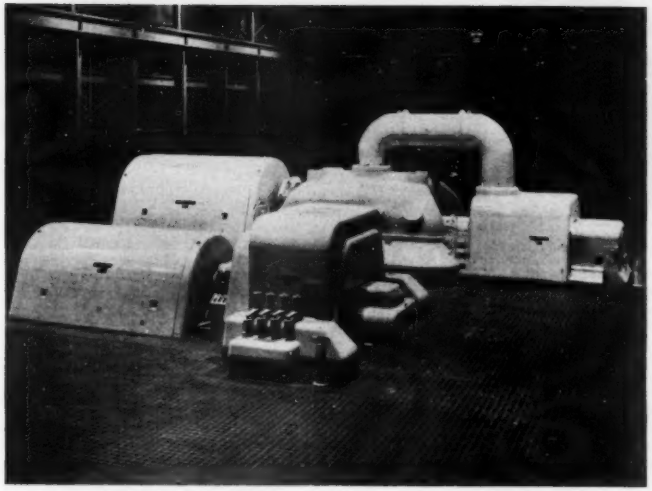
FIRST HALF OF PLANT will have two boilers per turbine, one stack per boiler. Ultimate station planned for four units. Short stacks used because of proximity to airport, nozzles produce 120-fps discharge velocity at maximum boiler rating

RIDGELAND Turbine Minimizes Outages

Newest Commonwealth Edison station uses cyclone furnaces, centralized control for coal handling; cross-compound turbine-generator units



DIAGRAMMATIC layout shows one of two 730,000-lb-per-hr steam generators feeding 150,000-kw cross-compound unit. Note steam tie to other units, bypass around h-p element of turbine allowing use of 1-p element alone. Feedwater, heated by one deaerating and four closed heaters, uses bleed steam. Figures refer to 700,000 lb-per-hr steam per boiler, 150,000-kw output, 21,000 lb-per-hr makeup



150,000-KW CROSS-COMPOUND UNIT uses 1800-psig 1050-F throttle steam. High-pressure element produces 50,000 kw at 3600 rpm, l-p element 100,000 kw at 1800

► COMMONWEALTH EDISON CO of Chicago recently dedicated its first new generating station in over 20 years. Ultimate capacity of the new Ridgeland Station in Stickney, Ill. will be 600,000 kw. Preliminary work started Aug 1947. The first 150,000-kw unit went on the line Oct 29, 1950. The second 150,000-kw unit, now under construction, starts in 1951. A third unit, already authorized, requires extending the building, and will run in 1953. The first unit brings total system net capacity up to 2,802,000 kw.

The station stands by the Chicago Sanitary and Ship Canal, which supplies cooling water. Central Illinois coal fields supply fuel to Ridgeland via rail and barge.

Expected net heat rate for the first unit equals 10,200 Btu per kwhr with 1800-psig 1050-F throttle steam, 1-in. backpressure and 460-F feedwater. At this rating boiler efficiency runs 87.5% and total auxiliary power about 7%.

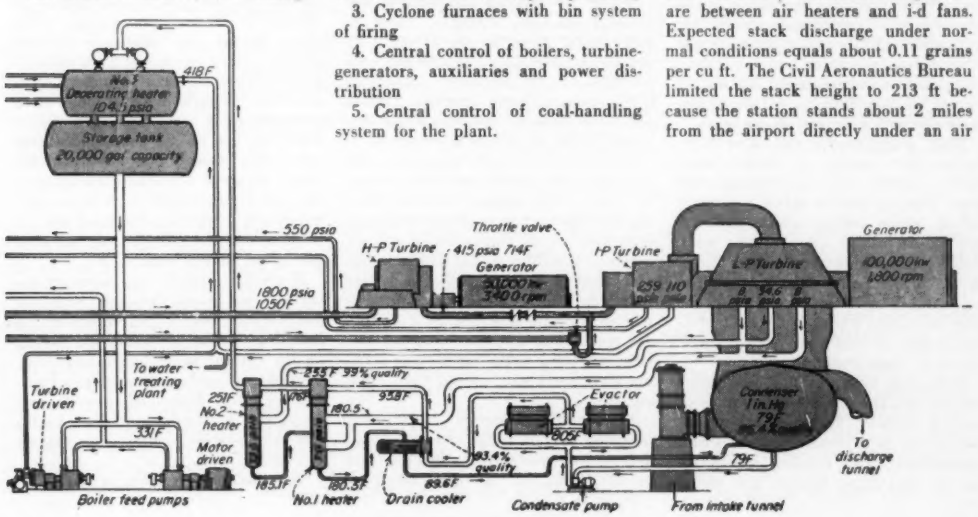
Outstanding features include:

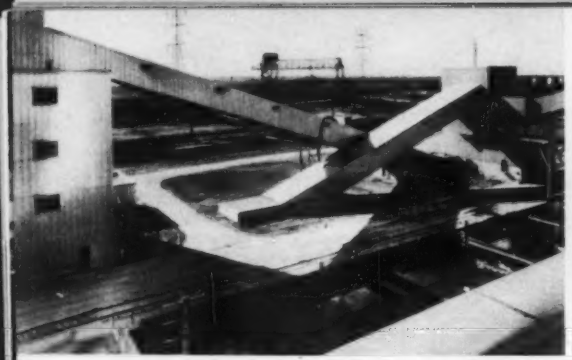
1. Architectural concrete and aluminum side-wall construction
2. Short stacks with high discharge velocities because of airport proximity
3. Cyclone furnaces with bin system of firing
4. Central control of boilers, turbine-generators, auxiliaries and power distribution
5. Central control of coal-handling system for the plant.

Steam Generators. Two cyclone-fired generators per unit produce 730,000 lb per hr each of 1900-psig 1050-F steam, continuously. Four-hour maximum rating reaches 770,000 lb per hour. Spray attemperators between primary and secondary sections of the pendant superheater control temperature. Four horizontal cyclone furnaces per boiler take crushed coal from 1400-ton coal bunkers through individual scales and apron feeders. The scales, subject to high primary air pressure at times, mount in pressure-tight housings with clean sealing air supplied to mechanism compartments. Natural gas and coal burn in the cyclones in combination or alone. Each cyclone receives automatically proportioned fuel and air quantities. Molten slag drains continuously from the inclined cyclone furnaces into the primary furnace and then through floor taps into quenching tanks.

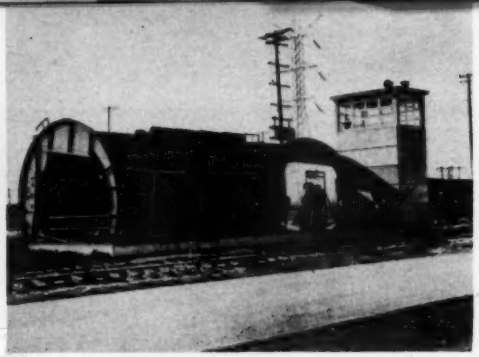
Two constant-speed induced-draft fans have inlet-vane control. Two constant-speed forced-draft blowers have inlet silencers and vane control. The f-d blowers feed combustion air at 60-in. water pressure maximum to a common duct. Sealing-type buttterfly damper in discharge of each blower operates automatically with starting and stopping of the respective blower. The common air duct leaving the air heater divides into four branches, one to each cyclone, with individual metering of air for control purposes. Automatic sequentially operated soot blowers with air as blowing medium are in the superheater, economizer and air heater.

Electrostatic precipitators supplement the cyclone-firing method to reduce stack solids to a minimum. Precipitators are between air heaters and i-d fans. Expected stack discharge under normal conditions equals about 0.11 grains per cu ft. The Civil Aeronautics Bureau limited the stack height to 213 ft because the station stands about 2 miles from the airport directly under an air





EXTENSIVE COAL-HANDLING system includes 283-ft span gantry crane in background, centrally-controlled conveyors



CAR DUMPER UNLOADS 100-ton rail cars for distribution of coal to storage pile or to crushing and boiler-room bunkers

lane. Stack nozzles produce discharge velocities of about 120 fps at maximum boiler rating.

Turbine-Generator. No. 2 (first unit installed) is a 150,000-kw cross-compound turbine with a 50,000-kw 3600-rpm h-p element and a 100,000-kw 1800-rpm tandem i-p l-p element. Both generators are designed for 85% pf and hydrogen cooling at 0.5 psig. With 15-psig hydrogen, unit capability rises to about 203,000 kva. Steam at 1800 psig and 1050 F enters the h-p cylinder through two double-plug-type throttle valves, two steam chests, eight plug-type governing valves and six segmental nozzle blocks. No stages are bypassed under overload. High-pressure cylinder has one velocity-compounded impulse stage and 13 reaction stages with one extraction point. The i-p cylinder has 27 reaction stages and two extraction points. The l-p cylinder has 10 double-flow reaction stages and two extraction points. Each of the two elements has its independent turning gear, oil reservoir and set of oil pumps. In addition to the shaft-mounted centrifugal pumps for governing and lubrication there are one steam-driven governing and lubrication pump and two motor-driven lubricating pumps for each element. All start automatically with failure of oil pressure.

Main steam header and other high-temperature piping is hollow-bored 2.25% chrome—1% molybdenum steel pipe. Turbine throttle valves, governing valves, steam chests, nozzle chamber and nozzle blocks are stainless steel. Hobbs joints connect ferritic-steel piping to the austenitic throttle valves. The h-p turbine cylinder, except for the aforementioned parts, is chrome-molybdenum and all blades are Westinghouse standard blade material.

Bypassing steam to the i-p turbine throttle provides for possible outage of the h-p element. Increased attemperation at the superheaters reduces steam temperature. This requires sectionalizing the unit steam header. Two check valves in series are in each of the two crossover pipes from h-p cylinder exhaust to the i-p cylinder inlet. These check valves are manually opened during compound operation. Check valves are spring loaded in closed position when the i-p l-p element runs alone. This eliminates need for relief valves on the h-p cylinder.

No. 5 heater doesn't function when the h-p element is out. Feedwater temperature drops from 460 to 390 F, increasing the turbine heat rate from 8150 to 10,475 Btu per kwhr. Entire unit must be taken out of service, when preparing for an outage of the h-p element, to open clips in the h-p generator leads.

Main condenser has a single-pass and divided waterbox. Either half can be inspected and cleaned during low-load operation. The two water circuits arranged in opposed directions have shut-off valves at inlet and outlet, and interconnecting valves between boxes. Flow can be reversed in either half for flushing.

Water for makeup and general use comes from Lake Michigan, about 10 miles away. Since the supply might be completely interrupted at intervals, two 200,000-gal underground reservoirs hold a reserve. Flow-proportioning methods inject chlorine into this water. Residual in the reservoirs is recorded.

Two 25,000-lb per-hr evaporators in the unit cycle distill pretreated makeup water. Pretreatment includes filtering, hydrogen cation exchange softening, degassing, caustic neutralization and deaeration. Installing a total demineralization plant is being considered. After the initial start the pretreatment system works automatically. Four 50,000-gal tanks store distilled water for two units. Distilled water for initially starting Unit No. 2 was trucked from other stations.

Coal-handling plant has facilities for receiving coal by barge or rail, moving coal to and from storage, breaking and crushing coal for the bin system of cyclone firing and delivery of crushed coal to boiler bunkers. Initial system has a series of single belts with capacity of 800 tph. Ultimate system will have parallel belts with valves and cross-tie arrangements to provide high degree of flexibility and outage facilities.

The 7.5-ton bucket of the traveling bridge crane unloads coal from barges and discharges to either of two parallel belts. These discharge to underground conveyors. Cars of 100-ton capacity, and 51-ft long, over couplings may be dumped in a 95-sec cycle, not including car moving. A motor-driven cable moves the cars.

Coal transported to the breaker house reduces to 1¼-in. minus with further reduction to 95% ¼-in. minus in hammermill crushers. Fines can be screened and bypassed around both breakers and crushers. The boiler bunkers receive the crushed coal.

The traveling dockside bridge crane with 283-ft 4.5-in. span straddles the coal-storage pile. Coal can be unloaded directly to the pile or discharged to storage by a traveling stacker. The crane bucket or bulldozers reclaim stored coal by moving it to a ground-level hopper above the underground conveyor. To serve other stations from this storage, a traveling barge loader works on one of the parallel dockside belts. The storage pile holds 325,000 tons compacted. A second dockside storage pile is contemplated. A tower-type crane will serve this pile. Coal will be reclaimed by another dockside belt supplying the underground belt.

A central control room remotely supervises conveyors, breakers, crushers and various feeders and valves in the handling system. A miniature system on the control panel indicates routing of coal and equipment running. Interlocks provide sequential starting and emergency sequential stopping. An intercommunication system coordinates operations.

Ash Handling. A hydrojet system in-

PRINCIPAL POWER-PLANT EQUIPMENT

Ridgeland Station, Stickney, Ill., Commonwealth Edison Co • First installation, Unit No. 2

STEAM-GENERATING EQUIPMENT:

Steam generators, 2 ..... Babcock & Wilcox Co
730,000 lb-per-hr continuous, 770,000 lb-per-hr max, 1900 psig, 1050 F, radiant watertube type, 4 cyclone furnaces per boiler, alternate gas firing, 22,164-sq-ft waterwall, 44,690-sq-ft superheater, 14,238-sq-ft economizer, 33,400-cu-ft furnace, 26,600 Btu per cu ft per hr max heat release

Air heaters, 2 ..... Babcock & Wilcox Co
Vertical, tubular, 2-section, 154,950 sq ft

Forced-draft blowers, 4 ..... Ingersoll-Rand Co
112,000 cfm, 60-in. static press., 1775 rpm, direct-coupled, inlet-vane control

F-d blower drives, 4 ..... Allis-Chalmers Manufacturing Co
Induction motors, 1500-hp, 1770-rpm, 4-kv, 3-ph, 60-cycle

Induced-draft fans, 4 ..... Sturtevant Div, Westinghouse Electric Corp
192,000-cfm, 16-in. static press., 360-F 880-rpm direct-coupled inlet vane control

I-d fan drives, 4 ..... Allis-Chalmers Manufacturing Co
Induction motors, 800-rpm 4000-v 3-phase 60-cycle

Coal scales, 8 ..... Stock Equipment Co
Dustproof automatic, 400-lb hopper, 18 tons per hr

Coal feeders, 8 ..... Babcock & Wilcox Co
24-in. apron type, Reeves variable-speed transmission

Water columns, bi-color, 4 ..... Diamond Power Specialty Corp

Utiliscopes, 2 ..... Diamond Power Specialty Corp

Safety valves, 7 ..... Crosby Steam Gage & Valve Co

Safety valves, 7 ..... Manning, Maxwell & Moore, Inc

Soot blowers ..... Diamond Power Specialty Corp
500-psig air supply, automatic sequential control

Chemical feeders, 2 ..... Hills-McCanna Co

TURBINE-GENERATOR EQUIPMENT:

Turbine-generator, 1 ..... Westinghouse Electric Corp
150,000-kw cross-compound, 1800-psig, 1050-F, 1-in. Hg abs exhaust, hydrogen-cooled separately excited. *H-p element:* 14-stage, 3600-rpm, 50,000-kw, 0.85-pf, 13.8-kv, 60-cycle. *L-p, i-p element:* 37-stage, tandem-compound, 1800-rpm, 100,000-kw, 0.85-pf, 13.8-kv, 60-cycle

Condenser, 1 ..... Allis-Chalmers Manufacturing Co
100,000-sq-ft, single-pass, divided waterbox, admiralty tubes, Muntz-metal tube sheets

Air evactors, 2 ..... Allis-Chalmers Manufacturing Co
Twin-element, 2-stage, 350-psig, steam pressure

Circulating-water pumps, 2 ..... Allis-Chalmers Manufacturing Co
Vertical mixed-flow, 77,500-gpm each, 26-ft head, 700-hp motor drive, 270-rpm

Chlorination equipment, 4 units ..... Wallace & Tiernan Co
6000 lb per hr each, automatic intermittent desliming

Condensate pumps, 3 ..... Allis-Chalmers Manufacturing Co
3-stage, 1000-gpm, 500-ft total head, 1750-rpm

Condensate-pump drives, 3 ..... Allis-Chalmers Manufacturing Co
Induction motors, 200-hp 1760-rpm 4000-v 3-phase 60-cycle

FEEDWATER SYSTEM:

Boiler feed pumps, 2 ..... Pacific Pumps, Inc
Horizontal, 10-stage, 800,000-lb-per-hr, 344-F, 2430-psig discharge press., 3550-rpm motor driven

Boiler feed pump, 1 ..... Byron Jackson Co
Horizontal, 9-stage, 800,000-lb-per-hr, 344-F, 2430-psig discharge press., 3550-rpm, steam turbine driven

Boiler-feed-pump drives, 2 ..... Allis-Chalmers Manufacturing Co
Induction motors, 3500-hp, 3582-rpm, 4000-v, 3-phase, 60-cycle

Boiler-feed-pump drive, 1 ..... General Electric Co
Single-stage steam turbine, 1800-psig, 1050-F, 112-psig exhaust, 3550-rpm

Drain cooler, 1 ..... American Locomotive Co
Horizontal straight-tube, 910 sq ft, admiralty tubes

Low-pressure heater No. 1 ..... American Locomotive Co
Vertical, straight-tube, 4700-sq-ft, admiralty tubes

Low-pressure heater No. 2 ..... American Locomotive Co
Vertical straight-tube, integral drain subcooler, 4925 sq ft, admiralty tubes

Deaerating heater, 1 ..... Worthington Pump & Machinery Co
Horizontal, direct contact, stainless-steel trays, 0.003-cc oxygen per liter, 21,500-gal storage tank

High-pressure heater No. 4 ..... American Locomotive Co
Horizontal U-tube integral drain cooler, 6020 sq ft, 70-30 copper-nickel tubes

High-pressure heater No. 5 ..... American Locomotive Co
Horizontal U-tube, integral drain cooler, 6300 sq ft, 70-30 copper-nickel tubes

MAKEUP SYSTEM:

Filters, 60-gpm, 2 ..... Permutit Co

Softeners, hydrogen cation exchange, 60 gpm, 2 ..... Permutit Co

Degasifier, 120 gpm, 10-ppm CO_2 ..... Permutit Co

Deaerator, 70,000 lb per hr, 1 ..... Permutit Co

Evaporators, 2 ..... Griscom-Russell Co
Horizontal submerged tubes, 25,000 lb per hr

Raw-water storage tank, 50,000 gal, 1 ..... Chicago Steel Tank Co

Distilled-water tanks, 50,000 gal, 4 ..... Chicago Steel Tank Co

Filter supply pumps, 1-stage, 150-gpm, 3 ..... Ingersoll-Rand Co

Treated-water pumps, 1-stage, 150-gpm, 3 ..... Ingersoll-Rand Co

Evaporator feed pumps, 1-stage, 150-gpm, 3 ..... Ingersoll-Rand Co

COAL-HANDLING SYSTEM:

Gantry crane, 1 ..... Wellman Engineering Co
800 tph, 7.5-ton bucket, 283-ft 4.5-in. span

Barge shifter, 1 ..... Wellman Engineering Co
20 fpm, 25,000-lb max pull, 10-hp motor drive

Stacking tripper, 1 ..... Link-Belt Co

Barge loader, 1 ..... Link-Belt Co

Car dumper, 100-ton, 1 ..... Wellman Engineering Co

Car puller, 1 ..... McKiernan-Terry Corp
40 fpm, 27,500-lb max pull, 30-hp motor drive

Belt conveyors ..... Link-Belt Co
800 tph, 500 fpm, 42-in.-wide main belts

Coal breakers, 2 (for 2 units) ..... Pennsylvania Crusher Co
Bradford hammermill, 500 ton per hr, 1¼-in. product

Coal crushers, 4 (for 2 units) ..... Pennsylvania Crusher Co
Reversible hammermill, 250 tph, 95% 1¼-in. minus product

Weightometers, 2 ..... Merrick Scale Manufacturing Co

SLAG- AND DUST-HANDLING SYSTEMS:

Electrical precipitators, 2 ..... Research Corp
384,000 cfm at 385 F, 80% efficiency guaranteed

Dust-handling system ..... Allen-Sherman-Hoff Co
Hydrovac system, automatic sequential control, 15 tph

Slag-handling system ..... United Conveyor Corp
Hydrojet system, 50 tons per hr

Ash-handling crane, 3-cu-yd bucket, 1 ..... Whiting Corp

ELECTRICAL EQUIPMENT:

Exciters, 3 ..... Westinghouse Electric Corp
300-kw 250-v flywheel-type, driven by 450-hp motor, 4000-v

Generator transformers, 6 ..... Allis-Chalmers Manufacturing Co
13,220/69,000-v, single-phase, 25,000-kva, self-cooled, 33,333-kva, forced-air cooled, 7.8% impedance at 25,000 kva

Oil circuit breakers, 69 kv ..... Allis-Chalmers Manufacturing Co
Single-phase 1200-amp 2,500,000-kva interrupting capacity

MISCELLANEOUS:

Station air compressors, 3 ..... Gardner-Denver Co
Two-stage, horizontal, 300 rpm, 1016-cfm free air, 110 psi, 200-hp synchronous motor, 3-phase, 60-cycle, 4000-v

Control air compressors, 3 ..... Ingersoll-Rand Co
Single stage, horizontal, 325 rpm, 150-cfm free air, 100 psig, V-belt, 40-hp induction motor, 1750-rpm, 3-ph, 60-cycle, 208-v

Soot-blower air compressors, 2 ..... Ingersoll-Rand Co
3-stage 327-rpm 1180-cfm free air, 500-psig, 400-hp synchronous motor, 3-phase, 60 cycle, 4000-v

Turbine-room cranes, 150-ton, 2 ..... Whiting Corp

Combustion control ..... Republic Flow Meters Co

Boiler-feed pump control ..... Republic Flow Meters Co

Feedwater regulators and control ..... Bailey Meter Co

Intercommunication system ..... Farmers Engineering & Manufacturing

General contractor ..... John Griffiths & Son Co

Consulting engineers ..... Sargent & Lundy

termittently sluices slag from the two quenching tanks on each boiler to an outdoor storage pit. The system is manually controlled. Flyash moves intermittently from the 16 precipitator hoppers per boiler, transported pneumatically under vacuum. After mixing with water in the multi-water-jet air ejectors the ash discharges to the outdoor storage pit. System has automatic sequential control. A clam-shell bucket dredges ash, slag and flyash from the outdoor pit and loads it into rail cars or trucks.

Central control centers in a single room for boilers, turbines, generators, major auxiliaries and transmission for all units. The 40x96-ft room will be extended to 160 ft ultimately, being centrally located in the completed building. Air conditioning and a slight positive pressure help keep the room clean. Fluorescent tubes above an eggcrate ceiling give a choice of 50 or 100 ft-candles on the benchboards.

Boiler and turbine-generator controls are on opposite sides of room. Transmission, auxiliary power and station auxiliary controls are at the eventual center of the room. In general, vertical back panels carry all instruments, and benchboards the controls. Since the control room stands as much as 350 ft from the equipment, controls and instruments with minimum lag characteristics had to be selected.

The combustion and boiler-feed-pump controls are Republic Flow Meters Co's new electronic system adapted to pneumatic actuators. For first complete details see *Electronics for the Power Engineer*, page 99.

(*Continued on page* 174)

AIR MOVEMENT in large, "free-space" areas is often slight; requires close, careful measurement

OUTLET VELOCITIES from ducts or grilles can vary across the outlet face. Average them out by a number of readings across equivalent sections

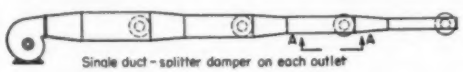
Time-Saving Steps for Balancing Air-

RECOMMENDED CHECK LIST

A—Balancing Procedure. Single-duct run or multiple-duct runs terminated by single outlets:

(1) Open all air-duct dampers and all outlet dampers.

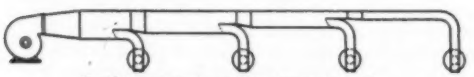
(2) Check at main intake or discharge duct near fan to see if total fan capacity is at least equal to design. Quantity of air the fan



Single duct – splitter damper on each outlet

is handling can usually be determined by measuring velocity at some accessible location in a straight-run duct and multiplying average velocity by section area.

(3) If fan capacity is adequate, determine capacity of least-favored air outlet. Check capacity of each outlet and compare it with design capacity. Measure actual outlet quantities at neck of ceiling diffusers or at face of the unit for grilles.



Single branch duct – splitter damper take off

(4) From step 3 determine capacity of least-favored outlet and its relationship percentagewise to design capacity. If greater than unity, reduce total air volume by main-duct dampers, or by decreasing fan speed if variable pitch diameter pulleys are used.

(5) If least-favored outlet ratio is less than unity, adjust all other outlets so the same ratio exists between the actual discharge and design quantities. Recheck and adjust if restricting the other outlets has increased the capacity of the least-favored outlet.

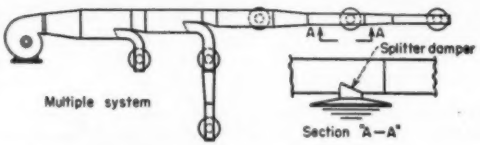
(6) After adjusting all outlets to the same ratio, increase fan capacity enough to bring all units up to design capacity.

B—Complicated Systems. Compound ducts in which there are multiple branches, each feeding a number of outlets or sub-duct branches:

(1) Open all duct and outlet dampers.

(2) Check fan capacity to see if it equals design capacity.

(3 Determine capacity of least-favored duct branch and adjust its

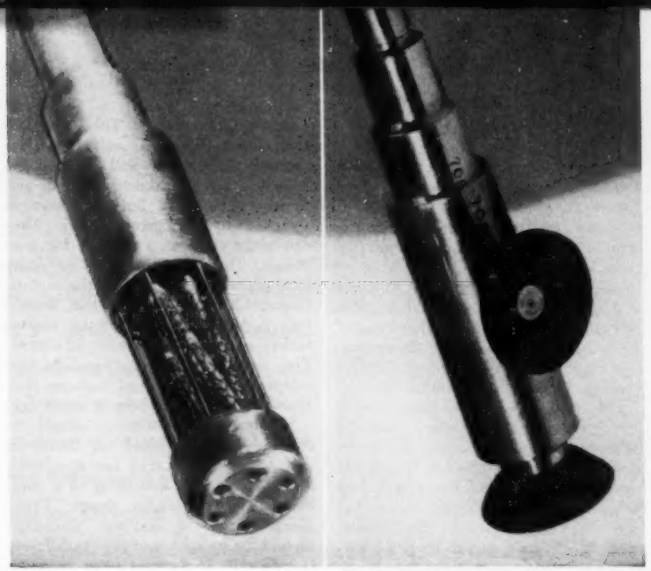


outlets with the least-favored outlet serving as a guide, as previously outlined.

(4) Regulate capacities of other branch ducts so they agree with least-favored duct branch in relation of actual to design capacities. Recheck to see if quantity of the least-favored branch has been unduly increased.

(5) Adjust fan speed to increase the capacity of entire system up to design rating.

If fans are not handling the proper air capacity, check items, such as direction of rotation, belt slippage or actual rpm of motor and fan shaft, fan-motor voltage.



SPECIAL AIR METER measures temperatures and velocities of air in free space, ducts or leaving outlets. Probe feeds collected information to indicating meters

Conditioning Systems

Too often balancing an air-conditioning system ends in a hopeless mess with some outlets starved and others banging away. Here are some suggestions on bringing order out of chaos

By L R PHILLIPS,
Research Director, Anemostat Corp

► BALANCING an air-conditioning system is often an act of juggling. Dampers go through several trial-and-error settings. They usually wind up at a median point, set somewhere between design air-conditioning quantities and the point where the patience of engineer and owner runs out. The problem becomes more complicated as the size of the job grows and outlets increase.

There are certain steps you can take and tools you can use that will shorten the job and make results more certain and acceptable whether you do it or delegate someone else. Even before the actual job gets under way certain preliminary steps will save time later.

Biggest step is to draw up a complete duct layout that shows: (1) total capacity of the system in cfm (2) outlet specifications and sizes (3) design outlet quantities (4) main-branch velocities, minor-branch velocities, neck or core velocities, neck or grille areas, cooling- and heating-coil inlet and outlet design conditions, including temperature, humidity, and air quantity (5) outlet-air design temperature, room-air design conditions including temperature, humidity, and acceptable maximum and minimum velocities (6) acceptable noise level in areas to be conditioned. Then collect for ready reference all manufacturers' catalogs covering the fans and air outlets used.

With this background whoever draws the job of balancing the system has some idea of what's expected. Further, if you tell him definitely what you want from your air-conditioning system he will know just what controls need the most attention. For instance, if you are the contractor closing out a job, you want outlet dampers adjusted to give quantities that agree as closely as possible with the engineer's layout. If you are the design engineer, you are more interested in getting a satisfactory air distribution within a room. The owner or user looks for still another factor—maintaining the most comfort.

Laying the Groundwork. Theoretically a duct can be laid out that distributes design air quantities through each outlet without regulating dampers. But experience shows it pays to install regulating dampers on each branch take-off and sometimes to use quantity control at each outlet. Errors in design or installation crop up from time to time. When they do, it is impossible to balance a system without first making a corrective adjustment.

A major corrective adjustment requires a good basic knowledge of the fundamentals of air flow, fan, duct and air-outlet performance. Data of this kind you find in handbooks, such as American Society of Refrigerating Engineers' *Refrigerating Data Book*, American Society of Heating and Ventilating Engineers' *Guide*, or *Fan Engineering*.

From these books, you would want to dig out information on fan laws before making any major adjustment. For example, you'd have to know basic facts like these: Air quantity varies as the speed with any particular fan-supply system. The static pressure varies as the square of the speed, and power consumption, as the cube of the speed. With fundamentals like these firmly in hand you can exercise some judgment when you begin to interpret the manufacturer's fan-performance curves. Manufacturers use different arrangements in plotting these curves, and without a basic understanding they can be confusing.

The same thing holds for air flow in ducts. Knowing that total pressure of air flow is made up of static pressure exerted in all directions, plus velocity pressure, helps in reaching any decision on the effects in total flow energy of (1) friction (2) direction changes (3) different duct areas.

Air outlets are almost a study in themselves. Air flow through aspirating diffusers, grilles, jets, perforated ceilings differ in each case. In all but the aspirating diffuser, air leaves in a single stream. In the case of jets and grilles the stream is usually directed over the zone of occupancy so terminal velocity drops to 50 or 60 fpm by the time the air has traveled three-quarters of the room length. Plaques work about the same except they are usually spotted in the center of the room and have a radial discharge.

Aspirating diffusers, though, pull a

portion of the room air into the diffuser to mix with and be redischarged with incoming air. If you try to take a quantity measurement of discharge velocities from these diffusers, your results won't make much sense unless you realize how the diffuser operates.

If you own or use air conditioning, make it a point to understand some of the physiological considerations in air conditioning. The sensation of draft, for instance, may result from localized cooling, unequal humidity, localized radiation of heat from a part of the body to some nearby cold spot as well as from too much air movement. Just being aware of this information can save you from too hasty adjustments.

Instruments. Once you have a background to go on, you start to gather data on what your system is doing. Instruments are your one way of compiling such information. A draft gage with or without a pitot tube, or with an Anemotherm air meter (photos, p 89) calibrated in inches of water, measures static pressure in plenum or duct. Each requires drilling a small hole in the duct or plenum. These same instruments can give you data on velocity by recording velocity pressure. Or you can get a velocity reading directly with rotating vane anemometers at the face of supply or exhaust grilles, deflecting vane anemometers or direct-reading, heat-loss-actuated thermo-anemometers.

These thermo-anemometers can measure discharge velocities of jets or grilles, also the neck velocities of circular or square unit outlets. But the directional characteristics of these instruments have to be taken into account. Some are more directional than others. When they are used in a turbulent stream or even in one where air flow is not definitely established, severe errors can develop. This same trouble holds for deflecting vane anemometers when used with prescribed attachments for duct, neck and discharge velocities.

For air measurement in free space the deflecting vane anemometer, various thermo-anemometers, the Kata-thermometer, and the rotating anemometer will do. The rotating anemometer, though, applies only to fairly large air masses moving in a constant direction at speeds of 200 fpm and above. The Kata-thermometer, while rather cumbersome and time-consuming, determines low velocities. Only a few instruments can be adapted for turbulent flow.

The nondirectional thermo-anemometer represents an important tool for measurement of turbulent velocities. It depends on cooling effect of moving air for its operation. When turbulent air passes over anemometer it cools the element. This effect, regardless of the value or direction of the localized turbulent velocities, is resolved by the instrument into an equivalent cooling effect caused by a stream of air in straight-line flow.

Still other instruments for balancing air-conditioning systems are sling or aspirating psychrometers, for humidity and wet-bulb temperature readings, and sound-level meters for noise intensity.

Damper Controls. Up to now all we've done is establish the knowledge and tools you need to balance an air-conditioning system. To make this background complete we should add a little on dampers and their control.

They are the most frequently used devices to balance an air-conditioning system. Usually you find them some distance back from the outlets in the supply duct with similar ones in the main return duct. Dampers, in general, do a satisfactory job of balancing if they are not so close to the outlet that they upset uniform flow or create a noise. As far as noise goes, it is a good idea to put the dampers in ahead of any acoustic duct treatment. This way, whatever noise develops as air passes through the dampers will be absorbed.

Dampers at the take-off locations perform satisfactorily, but use them as specified by the manufacturer. They can never serve as a cure-all for poor design. These same limitations apply to dampers placed behind the outlets. Homemade or job-fabricated devices such as blank-offs can be noisy and interfere with proper operation of outlets. The manufacturer has carefully developed his outlets, and because they operate reliably they help in balancing.

Splitter dampers directly behind air outlets cause one-sided air flows. In their place you should use equalizing deflector dampers, consisting of a number of adjustable flat vanes. These dampers give a uniform discharge around the periphery of the air diffuser. Occasionally because of room shape or obstructions in the normal air path you may want to use these equalizing deflectors in circular or square outlets as directional controls.

One recently developed damper has a set of adjustable turning vanes so the air can be adjusted directly at the ceiling outlet. It corrects unequal or one-sided discharges. In addition, it keeps down the velocity pressure loss, normally resulting from turning the air in the duct through the outlet. A device like this, working on the lower or exposed face of the air outlet, makes balancing much easier.

With any damper-controlled system, care must be taken to avoid restricting output from an appreciable number of outlets. This could decrease the total volume of air handled and cause static pressure at the fan to increase. The increased pressure, in turn, raises air velocities through all outlets to where it might possibly make noise.

Final Adjustments. Often just adjusting system capacity, as in Balancing Procedure, p 88, is all that's needed. If you want the most advantageous room-air distribution as well, there is still more you can do. Louvers of grilles, equalizing deflectors, blank-off baffles and air-flow pattern regulation, if a part of the system, need going over. With the same careful regard of overall effect on the system these last steps can prove valuable.

A check of air motion in the room sometimes indicates your course of action. The occupied zone—from the floor to a height of 6 ft—should have an air motion that complies with acceptable velocities (20 to 50 fpm) and should preferably be turbulent. If air conditioning is not the only source of heat then room air velocities should be higher for optimum comfort.

SUGGESTED INSTRUMENT AIDS

PRESSURE

Static—Draft gages, Anemostat air meter, p 89

Velocity—Pitot tubes, rotating-vane anemometer, deflecting vane anemometers, direct-reading, heat-loss-actuated thermo-anemometers, Anemostat air meter

MOTION

Free space—Deflecting vane anemometer, various thermo-anemometers, Kata-thermometer, rotating anemometer, Anemostat air meter

Turbulent—Nondirectional thermo-anemometer, Anemostat air meter

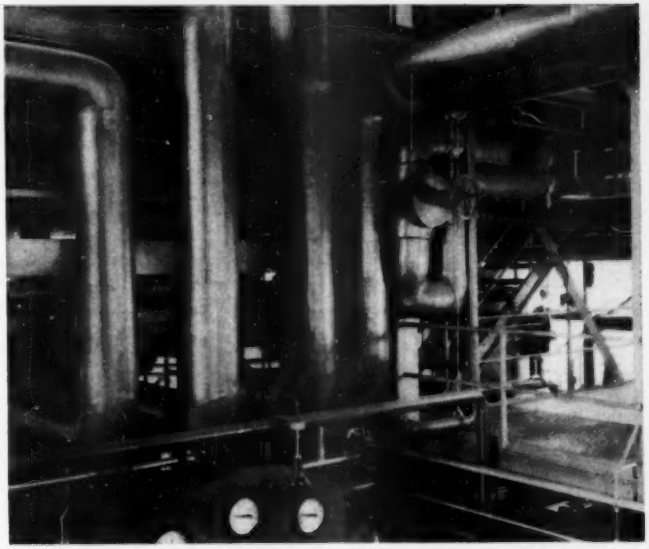
HUMIDITY

Sling or aspirating psychrometers

NOISE

Sound level (decibel) meters

Frank Kamarck, ME, New York, N.Y., combines two well-established methods of stress calculation and comes up with a relatively easy means for finding deflections of pipe operating at elevated temperatures. For your next main steam-pipe designing job, use . . .



ACCURATE MOVEMENT CALCULATIONS are needed for main steam pipes and other lines that operate at high temperature. Movement must be known to pick hangers

Easier Way to Find Hot-Pipe Movement

► IN POWER-PLANT DESIGN it's a well-established procedure to make careful stress calculations for main steam piping connecting boilers to turbines. Boiler and turbine manufacturers state limiting forces and moments allowable at flanges of their equipment. Because main steam piping is a high-cost item in which pressure drop must be kept to a minimum, it is usually designed near the allowable limits for stress, forces and moments. This leaves design engineers with the problem of correctly hanging pipe so that no—or little additional—stress, forces or moments result from weight of pipe.

Pipe Movement. To select proper hangers, POWER, Jan 1951, p 75-77, movement of pipe must be accurately established. One means for finding movement is based on the tried and proven grapho-analytical method of analyzing pipe stresses. Crocker's *Piping Handbook* (McGraw-Hill Book Co, 1945) describes the method in detail.

It is based on finding the angular rotation of component parts due to forces and moments and converting this angular rotation into deflection. Deflections for each point are combined algebraically with the straight expansion from the working anchor point to find movement of each point. If only vertical movements are desired, and vertical direction is designated as *y* in stress calculations, then only planes *xy* and *yz* need be analyzed for deflections. As in grapho-analytical stress analysis, component parts are analyzed as separate cantilevers. One end is assumed fixed; forces and moments from stress calculations are applied to other end.

Calculations. To illustrate use of moments and forces in pipe-movement calculations a 3-dimensional piping problem from S W Spielvogel's *Piping Stress Calculations Simplified* (McGraw-Hill Book Co, 1943) is reproduced on the next two pages. This is problem No. 9 from his book and is readily followed by those familiar with his method. For those designers who are unacquainted with Spielvogel's method, I suggest referring to his book. The method is simple and widely used. (POWER, Jan and Feb 1941, published two articles on this method of stress calculation for high-temperature pipes.)

Deflections obtained are those caused by forces and moments that must be applied to bring the assumed free end of piping system back to its anchor. Values of angular rotation and deflection for shapes like straight lengths, arcs of circles, and others, are given in the *Piping Handbook*. Since stress calculations are generally made with assumed square corners replacing the actual weldells, only values for straight lengths are given later in the article.

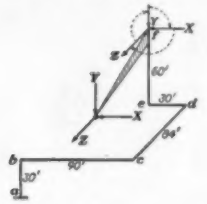
Using these data compute angular rotation and deflection of the pipe at each point as shown on page 93. Sign of angular rotation is usually taken as plus for clockwise, but it should always be taken the same as for moments in the stress calculations. Sign of deflections is same as that for plane under consideration in the stress calculations. Signs of deflections are independent of signs for angular rotation.

Algebraically combine deflections for various points with straight expansion movement from working anchor point to obtain resultant movement at a point. Proof of the correctness of a set of movement calculations is whether resultant movement at the two anchor points is zero, or whatever movement anchor is supposed to have. If this is not so for a set of calculations, there is an error either in the original stress calculations or in the movement calculations. Calculated movements are summarized in Table II, p 93.

To obtain movements of intermediate

STRESS CALCULATION USING SPIELVOGEL'S METHOD FOR 3-DIMENSIONAL PIPING SYSTEM

24-in. pipe, Schedule 80
t = 1.218 in.
I = 5,673 in.^{4}
S = 472 in.^{3}
Temperature = 750°F
Pressure = 830 psi
Inside area = 364 sq in.
Area of metal = 87.17 sq in.
Expansion = 6.25 in./100 ft
$E = 26 \times 10^6$ psi



$$\Delta x = \frac{6.25 \text{ in.}}{100} \times (90 \text{ ft} - 30 \text{ ft}) = 3.75 \text{ in.}$$

$$\Delta y = \frac{6.25 \text{ in.}}{100} \times (60 \text{ ft} + 30 \text{ ft}) = 5.62 \text{ in.}$$

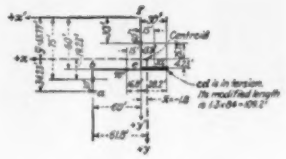
$$\Delta z = \frac{6.25 \text{ in.}}{100} \times 84 \text{ ft} = 5.25 \text{ in.}$$

$$\Delta x\,EI = \frac{3.75 \text{ in.}}{12} \times 25 \times 10^6 \times 5{,}673 \times \frac{1}{144} = 308{,}000{,}000 \text{ lb ft}^2$$

$$\Delta y\,EI = \frac{5.62 \text{ in.}}{12} \times 25 \times 10^6 \times 5{,}673 \times \frac{1}{144} = 460{,}000{,}000 \text{ lb ft}^2$$

$$\Delta z\,EI = \frac{5.25 \text{ in.}}{12} \times 25 \times 10^6 \times 5{,}673 \times \frac{1}{144} = 430{,}000{,}000 \text{ lb ft}^2$$

PROJECTION IN XY-PLANE



CENTROID

	l, ft	x', ft	lx'	y', ft	ly'
ab	30	60	1,800	75	2,250
bc	90	15	1,350	60	5,400
cd	109.2	−30	−3,276	60	6,550
de	30	−15	− 450	60	1,800
ef	60	0	0	30	1,800
Σl = 319.2			− 576		17,800

$x = -\frac{5.76}{319.2} = -1.8$ ft $y = \frac{17{,}800}{319.2} = 55.77$ ft

I_{xy}

	x, ft	y, ft	Ixy
ab	61.8	19.23	+35,700
bc	16.8	4.23	+ 6,400
cd	−28.2	4.23	−13,030
de	−13.2	4.23	− 1,670
ef	1.8	−25.77	− 2,750
			I_{xy} = +24,650

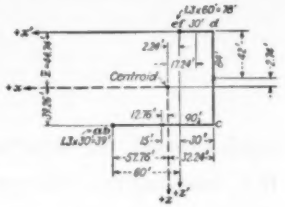
I_x

ab	$\frac{30^3}{12} + 30 \times 19.23^2$ = 13,400
bc	90×4.23^2 = 1,615
cd	109.2×4.23^2 = 1,955
de	30×4.23^2 = 540
ef	$\frac{60^3}{12} + 60 \times 23.77^2$ = 57,700
	I_x = 75,310

I_y

ab	30×61.8^2 = 114,500
bc	$\frac{90^3}{12} + 90 \times 16.8^2$ = 86,250
cd	109.2×28.2^2 = 87,000
de	$\frac{30^3}{12} + 30 \times 13.2^2$ = 7,400
ef	60×1.8^2 = 195
	I_y = 295,345

PROJECTION IN XZ-PLANE



CENTROID

	l, ft	x', ft	lx'	z', ft	lz'
ab	39	60	2,340	84	3,276
bc	90	15	1,350	84	7,560
cd	84	−30	−2,520	42	3,528
de	30	−15	− 450	0	0
ef	78	0	0	0	0
Σl = 321			+ 720		14,364

$x = \frac{720}{321} = 2.24$ ft $z = \frac{14{,}364}{321} = 44.74$ ft

I_{xz}

	x, ft	z, ft	Ixz
ab	57.76	39.26	88,400
bc	12.76	39.26	45,080
cd	−32.24	− 2.74	7,420
de	−17.24	−44.74	23,100
ef	− 2.24	−44.74	7,800
			I_{xz} = 171,800

I_z

ab	39×39.26^2 = 60,000
bc	90×39.26^2 = 138,800
cd	$\frac{84^3}{12} + 84 \times 2.74^2$ = 50,230
de	30×44.74^2 = 60,000
ef	78×44.74^2 = 156,000
	I_z = 465,030

I_x

ab	39×57.76^2 = 130,000
bc	$\frac{90^3}{12} + 90 \times 12.76^2$ = 75,350
cd	84×32.24^2 = 87,500
de	$\frac{30^3}{12} + 30 \times 17.24^2$ = 11,180
ef	78×2.24^2 = 390
	I_x = 304,420

TABLE I: MOMENTS

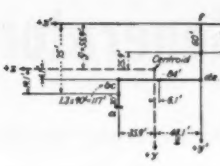
Point		xy-plane	xz-plane	yz-plane	
a		−1,226 lb × 34.23 ft + 900 lb × 61.8 ft =	−1,226 lb × 39.26 lb + 1,930 lb × 57.76 ft =	+900 lb × 35.9 ft − 1,930 lb × 34.1 ft =	
		BM = +13,600	T = +63,300	BM = −32,500	
		Resultant BM = +36,000			
b		−1,226 lb × 4.23 ft + 900 lb × 61.8 ft =	Same as for a	+900 lb × 35.9 ft − 1,930 lb × 4.1 ft =	
		+50,410	+63,300	+24,380	
		T = 63,300 BM = 55,900	T = 24,380 BM = 80,500		
c		−1,266 lb × 4.23 ft − 900 lb × 38.2 ft =	−1,226 lb × 39.26 ft − 1,930 lb × 32.24 ft =	Same as for b	Maximum bending moment 115,000
		−30,570	−110,400	+24,380	
		T = 24,380 BM = 115,000	T = 30,570 BM = 113,000		
d		Same as for c	+1,226 lb × 44.74 ft − 1,930 lb × 32.24 ft =	−900 lb × 48.1 ft − 1,930 lb × 4.1 ft =	Resultant bending moments are smaller than at c [by inspection]
		−30,570	−7,400	−51,200	
e		−1,226 lb × 4.23 ft + 900 lb × 1.8 ft =	+1,226 lb × 44.74 ft − 1,930 lb × 2.24 ft =	Same as for d	
		−3,570	+50,500	−51,200	
f		+1,226 lb × 55.77 ft + 900 lb × 1.8 ft =	Same as for e	−900 lb × 48.1 ft + 1,930 lb × 55.9 ft =	Resisting moments
		BM = +70,000	T = +50,500	BM = +64,600	
		Resultant BM = 95,200			

points, set up a simple proportion. This is accurate enough for most practical purposes. But if an exact calculation of movement at such points is needed, moments must be worked out from stress calculations and these points included as part of the movement calculation.

Angular Rotation, Deflection. Use these values for movement calculations: Angular rotation: (1) Σ of previous rotation = a; (2) $\psi_F = Fl^2/2EI = b$; (3) $\psi_M = Ml/EI = c$; $\Sigma\psi = a+b+c$. Deflection: (1) $al = d$; (2) $2bl/3 = e$; (3) $cl/2 = f$. Deflection = $d+e+f$ in direction of force F. Symbols: l = virtual length from centroid table in stress calculations, ft; ψ_F = angular rotation due to force, radians; ψ_M and ψ_{Mt} are angular rotation, radians, due to bending and torsional moments, respectively; M = bending moment, ftlb; E = modulus of linear elasticity of pipe material at operating temperature, psi; I = moment of inertia of pipe cross-section, in.^{4} (Use $I/1728$ when L is in feet.)

WHEN MAKING MOVEMENT CALCULATIONS FOR A HOT PIPE, FORM, BELOW RIGHT, IS HANDY

PROJECTION IN YZ-PLANE



CENTROID

	l, ft	y', ft	ly'	z', ft	lz'
ab	30	75	2,250	84	2,520
bc	117	60	7,020	84	9,828
cd	84	60	5,040	42	3,528
de	39	60	2,340	0	0
ef	60	30	1,800	0	0
Σl =	330		18,450		15,876

$\bar{y} = \frac{18,450}{330} = 55.9$ ft $\bar{z} = \frac{15,876}{330} = 48.1$ ft

I_{yz}

	y, ft	z, ft	lyz
ab	19.1	35.9	+ 20,570
bc	4.1	35.9	+ 17,200
cd	4.1	− 6.1	− 2,100
de	4.1	−48.1	− 7,680
ef	−25.9	−48.1	+ 74,750
		I_{yz} =	+102,740

I_y

ab	30×35.9^2 = 38,700
bc	117×4.1^2 = 150,800
cd	$\frac{84^3}{12} + 84 \times 6.1^2$ = 52,500
de	39×48.1^2 = 90,000
ef	60×48.1^2 = 139,000
	I_y = 471,000

I_z

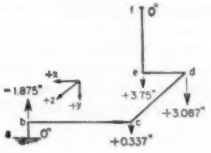
ab	$\frac{30^3}{12} + 30 \times 19.1^2$ = 13,194
bc	117×4.1^2 = 1,967
cd	84×4.1^2 = 1,412
de	39×4.1^2 = 656
ef	$\frac{60^3}{12} + 60 \times 25.9^2$ = 58,248
	I_z = 75,477

TABLE II: VERTICAL MOVEMENTS

At point	Deflections, inches, due to forces in XY plane	Deflections, inches, due to forces in YZ plane	Accumulated deflections, in Y-direction, inches
a	0	0	0
b	0	0	0
c	+2.212	0	+2.212
d	0	+2.75	+4.962
e	+0.663	0	+5.625
f	0	0	+5.625

At point	Σ Expansion in Y-direction from point a, inches	Resultant movement, inches
a	0	0
b	0.0625 × 30 = −1.875	−1.875
c	" " = −1.875	+2.212 − 1.875 = +0.337
d	" " = −1.875	+4.962 − 1.875 = +3.087
e	" " = −1.875	+5.625 − 1.875 = +3.75
f	0.0625 × 90 = −5.625	+5.625 − 5.625 = 0

Expansion = 0.0625 in. per ft



XY PLANE

F_x = +1226 lb
F_y = +900 lb
2EI ÷ 1728 = 164,000,000
EI ÷ 1728 = 82,000,000

Direction for angular rotation

Direction for deflections

Point b

M_b = +50,410 ft lb

ANGULAR ROTATION	DEFLECTION
1) Σ of previous rotation = 0	1) 0
2) $\psi F_x = \frac{1226 \times (30)^2}{164,000,000}$ = −0.00672	2) 0.00672 × $\frac{2}{3}$ × 30 = +0.1344
3) $\psi M_b = \frac{50,410 \times 30}{82,000,000}$ = +0.01844	3) 0.01844 × $\frac{1}{2}$ × 30 = −0.2766
ψb = +0.01172	Δx = −0.1422 in Δy = 0

Point c

M_c = −30,570 ft lb

1) Σ Previous rotation ψb = + 0.01172	1) 0.01172 × 90 = + 1.054
2) $\psi F_y = \frac{900 \times (90)^2}{164,000,000}$ = + 0.04440	2) 0.0444 × $\frac{2}{3}$ × 90 = + 2.664
3) $\psi M_c = \frac{30,570 \times 90}{82,000,000}$ = − 0.03354	3) 0.03354 × $\frac{1}{2}$ × 90 = − 1.506
ψc = + 0.02258	Δy = + 2.212 in Δx = 0

Point d

cd = 109.2'

M_d = −30,570 ft lb

1) Σ Previous rotation ψc = + 0.02258	Δx = 0
3) $\psi M_d = \frac{30,570 \times 109.2}{82,000,000}$ = −0.0407	Δy = 0
ψd = −0.01812	

Point e

M_e = −3,570 ft lb

1) Σ Previous rotation ψd = − 0.01812	1) 0.01812 × 30 = + 0.544
2) $\psi F_y = \frac{900 \times (30)^2}{164,000,000}$ = − 0.00494	2) 0.00494 × $\frac{2}{3}$ × 30 = + 0.099
3) $\psi M_e = \frac{3570 \times 30}{82,000,000}$ = − 0.00131	3) 0.00131 × $\frac{1}{2}$ × 30 = + 0.020
ψe = −0.02437	Δx = 0 Δy = + 0.663 in.

Point f

M_f = + 70,000 ft lb

1) Σ Previous rotation ψe = − 0.02437	1) 0.02437 × 60 = + 1.462
2) $\psi F_x = \frac{1226 \times (60)^2}{164,000,000}$ = − 0.02690	2) 0.0269 × $\frac{2}{3}$ × 60 = + 1.076
3) $\psi M_f = \frac{70,000 \times 60}{82,000,000}$ = + 0.05120	3) 0.0512 × $\frac{1}{2}$ × 60 = − 1.536
	Δy = 0, Δx = + 1.002 in.

YZ PLANE

F_y = + 900 lb
F_z = + 1930 lb
2EI ÷ 1728 = 164,000,000
EI ÷ 1728 = 82,000,000

Direction for angular rotation

Direction for deflections

Point b

M_b = + 24,380 ft lb

ANGULAR ROTATION	DEFLECTION
1) Σ of previous rotation = 0	1) 0
2) $\psi F_z = \frac{1930 \times (30)^2}{164,000,000}$ = − 0.01059	2) 0.01059 × $\frac{2}{3}$ × 30 = + 0.212
3) $\psi M_b = \frac{24,380 \times 30}{82,000,000}$ = + 0.00892	3) 0.00892 × $\frac{1}{2}$ × 30 = − 0.134
ψb = − 0.00167	Δy = 0, Δz = + 0.078 in.

Point c

bc = 117'

M_c = + 24,380 ft lb

1) Σ Previous rotation ψb = − 0.00167	Δy = 0
3) $\psi M_c = \frac{24,380 \times 117}{82,000,000}$ = +0.0348	Δz = 0
ψc = 0.03313	

Point d

M_d = − 51,200 ft lb

1) Σ Previous rotation ψc = + 0.03313	1) 0.03313 × 84 = + 2.78
2) $\psi F_y = \frac{900 \times (84)^2}{164,000,000}$ = + 0.03873	2) 0.03873 × $\frac{2}{3}$ × 84 = + 2.17
3) $\psi M_d = \frac{51,200 \times 84}{82,000,000}$ = −0.05245	3) 0.05245 × $\frac{1}{2}$ × 84 = −2.20
ψd = + 0.01941	Δz = 0, Δy = + 2.75 in.

Point e

de = 39'

M_e = −51,200 ft lb

1) Σ Previous rotation ψd = + 0.01941	Δy = 0
3) $\psi M_e = \frac{51,200 \times 39}{82,000,000}$ = −0.02436	Δz = 0
ψe = −0.00495	

Point f

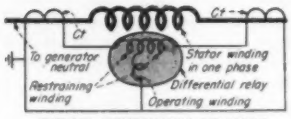
M_z = + 64,600 ft lb

1) Σ Previous rotation ψe = − 0.00495	1) 0.00495 × 60 = + 0.297
2) $\psi F_z = \frac{1930 \times (60)^2}{164,000,000}$ = − 0.04236	2) 0.04236 × $\frac{2}{3}$ × 60 = + 1.694
3) $\psi M_f = \frac{64,600 \times 60}{82,000,000}$ = + 0.04727	3) 0.04727 × $\frac{1}{2}$ × 60 = − 1.418
	Δy = 0, Δz = + 0.573 in.

MOVEMENT CALCULATIONS for a 3-dimensional piping system. Follow this form when using this method for main steam piping and other systems at a high temperature

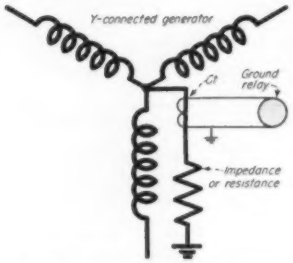
Sound Engineering Plus Economy Simplifies Modern . . .

. . . Relay Protection for Ac Generators

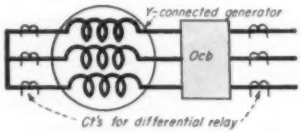


TYPICAL DIFFERENTIAL RELAYING

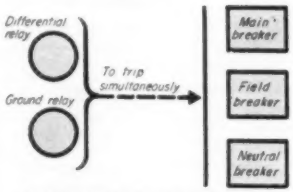
Here is a summary of AIEE Relay Committee's report* based on information received from 25 operating groups. Data refer to 3-phase, 11- to 15-kv machines rated 10,000 kva and above



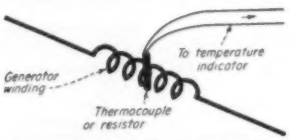
GROUND RELAY IN MACHINE NEUTRAL



EXTEND PROTECTED ZONE PAST OCB



RECOMMENDED TRIPPING SEQUENCE



DETECTORS FOR OVERHEATED STATOR

STATOR needs differential and ground relays

► STATOR-WINDING FAILURE, meaning an insulation failure, may result from reduced dielectric strength of the insulation or a transient overvoltage. The latter may stem from switching, lightning or a combination of overspeed and sudden loss of load.

Differential Protection. Differentially connected current relays protect each phase winding of a generator. Differential protection is usually installed on generators rated over 5000 kva and operating at 2.3 kv or above. In addition, use ground relays where the generator neutral is grounded. This ground connection is usually through an impedance to limit fault current.

High-voltage generators are usually Y-connected. They may have their neutrals solidly grounded; grounded through an impedance; or they may be isolated from ground. Generally some impedance is used to limit single-phase-to-ground fault currents. The limiting value is often the 3-phase short-circuit current.

Effectiveness of differential protection depends on available ground current. When the latter is high, as when low-impedance grounding is used, differential relays respond to ground faults on all but a small percentage of the winding near the neutral. But as neutral impedance is increased differential relays protect a progressively smaller percentage of the winding. Ultimate is the point where there is no further use for recognizing ground faults.

To gain full advantage of differential protection, ground the neutral or operate generator in parallel with another machine whose neutral is grounded. Ground current should at least approximate full-load current.

Shorted Turns. Although differential relays will operate on phase-to-phase or phase-to-ground faults, they will not recognize faults between turns of the same phase. The various schemes proposed to handle shorts between turns usually call for bringing out additional terminals from the machine to install current balance relays. This is often impractical in large modern generators.

An open-circuit winding is not likely simply because of the physical size of the conductors. Hence open-circuit protection is not generally provided.

Protected Zone. Differential relays should include the generator leads and extend to far side of main breaker.

Generator differential and ground relays should trip simultaneously the main-, field-, and neutral-breakers. Some engineers, however, feel tripping of the neutral breaker should be delayed till both main- and field-breakers are open. Reasoning is that there is possibility of transient voltage stresses developing if the neutral-breaker opens before the others. Nevertheless, from the standpoint of getting maximum speed in clearing, all three breakers should be tripped simultaneously. In addition to tripping the generator breakers, differential relays are often arranged to shut down the prime mover, operate fire-extinguishing equipment and actuate various alarms.

ROTOR faults often spotted by ground indicator and vibration detection equipment

Generator-rotor (field) troubles may be classified as grounds, shorts and opens in field windings and overheating. If only a few turns are shorted in rotor winding it will not be detected by overcurrent relays. Furthermore, field circuits should not be opened during system disturbances when a high current may be induced in the field winding. For these reasons overcurrent protection is generally not considered for field windings.

If one pole becomes shorted, resulting magnetic unbalance can be detected by vibration-detection equipment arranged to operate an alarm.

*Presented before AIEE Winter General Meeting, January 1951.

SPECIFIC RECOMMENDATIONS

1 Differential and ground relays generally recommended. They should trip main-, field-, and neutral-breakers simultaneously.

2 Zone protected by differential relays should extend to far side of main-breaker.

3 Temperature indicators will detect stator overheating.

4 Rotor overcurrent tripping protection not generally recommended.

5 Back-up protection is sound.

6 Overvoltage protection for hydro units subject to overspeed.

...PLUS TIPS ON GROUNDING AND TRIPPING SEQUENCE

Connect impedance in series with generator neutral to limit single-line ground faults to, or less than, the 3-line short-circuit current. Use resistance where underground cable feeder circuits are supplied at generator voltage; neutral reactance acceptable for small cable system.

Neutral-Breaker. If generators use common neutral resistor or reactor and connect to common bus, neutral-breaker is in order. Breaker should limit possible damage to generator iron in ground faults when low impedance grounding is used.

Terminal Voltage. Preference is for 13.8 kv. General opinion favors use of automatic voltage regulation.

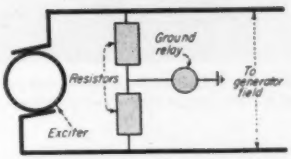
Breaker Tripping Sequence. If protective relays clear generator, in what sequence should generator breaker and control devices operate? Devices involved: main-, field-, neutral-breaker, main exciter field, annunciator or bell alarm, turbine throttle valve, fire-extinguishing equipment, field-discharge resistor switch.

Devices designed to be tripped on a particular fault are tripped simultaneously. Main-, field- and neutral-breakers, and annunciator or alarm are all tripped in each case. Main exciter breaker tripped in about 60% of cases. It's general practice for generator relays to trip throttle valves of steam turbines.

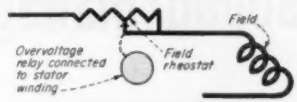
Grounded field winding is not serious in itself. But serious damage may result if a second ground occurs. A simple ground indicator consists of two lamps in series across the rotor winding with their midpoint grounded. But this scheme gives positive indication only for faults near field-winding ends. More sensitive ground indication can be had by replacing the lamps with resistors and connecting the midpoint to ground through a sensitive relay.

Overheating. Excess rotor current, ventilating-system failure, single-phase or unbalanced current operation may cause rotor overheating. Excess field current can result from failure in rheostat or voltage regulator. Slight temperature rise may be detected in ventilating system from rotor overheating. But it's doubtful if this rise can be depended on to call attention to rotor overheating.

Single-phase or unbalanced current operation will cause local heating in rotor pole faces. Severe vibration will accompany this condition. But protection against unbalanced current operation is not generally provided for attended machines. Phase ammeters on the switchboard and vibration indicators spot this condition.



KNOWING WHEN FIELD IS GROUNDED



OVERVOLTAGE PROTECTION FOR HYDRO

GENERAL protection includes power-directional and back-up relaying

Power directional relays give an alarm when power flows from the bus back toward generator. It trips the machine if power reversal holds on long enough to cause possible damage to turbine from overheating. Highly sensitive power directional relays, developing maximum torque at unity power factor, have been used. Generally a one-minute time delay is permissible between the time the alarm is given and when tripping should occur. After alarm is given tripping may be left to operator's discretion. Time-delay feature prevents tripping generator breaker on power surges caused by synchronizing or system disturbances.

Loss of Field. When a loaded generator loses its field the magnetic coupling between rotor and stator is weakened. Hence the rotor advances and after a short period pulls out of synchronism with the system. Remember, an alternator running as an induction generator, which is actually the case here, has heavy currents circulating in the face of the rotor particularly toward the ends. These may cause injurious local heating and arcing at metal wedges in the slots. An induced voltage or current will appear in the field circuit depending on whether the winding is open- or short-circuited.

Often if a large generator loses field completely (assuming it is not equipped with automatic generator-voltage regulators) system voltage may drop to a serious low within 10 or 15 sec. Loss-of-field protection has been developed for protecting generators against partial as well as complete loss of field.

Need for such a field scheme lies generally in those systems where one or more of following conditions exist: (1) Most generators are not equipped with automatic voltage regulators. (2) One generator represents a fairly large portion of the total generation. (3) Generators loosely linked electrically.

Provide a control-switch interlock to prevent opening the field breaker while the machine breaker is closed. If an alert operating force is always in attendance, loss-of-field protection may not be necessary.

Single-Phase Operation. When a polyphase machine single-phases there is local heating of the pole faces of rotor and amortisseur winding. On top of that severe vibrations are set up. Machines for single-phase operation are equipped with especially heavy amortisseur windings and spring mounting for the stator assembly. Protection against single-phase operation is not ordinarily provided for attended machines. Phase ammeters and vibration meters indicate this trouble.

Miscellaneous. Relays have been developed to recognize out-of-step operation, overvoltage, overspeed, vibration, failure of bearing insulation. Water or CO_2 may be released into the winding as protection against generator fires. But fire-extinguishing equipment may not be necessary in hydrogen-cooled generators since fire cannot be supported by hydrogen atmosphere.

Back-up protection should be incorporated. And back-up relays are those that clear a faulted piece of equipment if protective equipment, which would normally clear the fault, fails to operate.

CHIEF HOLZ USES HIS NAVY-LEARNED LUBRICATION AND MAINTENANCE PLANS IN SETTING . . .

LUBE-OIL TEST samples are now sent periodically to oil supplier. He in turn analyzes them and makes a complete report. Oil sampling also tells when the oil filters need changing. For the diesel lube, filters are good for about 400 to 600 hours

Sound Management Perks Up Columbia's

Keeping life in an old power plant calls for adoption of modern techniques in lubrication and maintenance. Engineer C Henry Holz, Columbia University, does just that. Here are his answers to on-the-spot questions by Associate Editor Jim O'Connor

HERE'S THE PLANT AT A GLANCE...

"Our power plant was built in 1897. Two of the original steam engines plus some of the boilers are still in operation. The twelve original boilers were rated at 5000 lb per hr. Engine generators rated at 220 kw each. To date all generated electric power is dc.

"More generating equipment was added as load grew. There was the vertical 450-kw engine in 1906, and two 300-kw horizontal engines in 1919. When 1924 rolled around two straight-tube boilers rated 25,000 and 19,000 lb per hr upped our steaming capacity. Exhaust and some live steam are used for heating.

"Our first diesels entered the picture in 1926. They were German made, one rated 250 kw and the other 350 kw. This held the load pretty well till 1931. At that time there was an increased demand for electricity as well as steam. The answer lay in two boilers, 39,000 and 20,000 lb per hr. Electrical end was further increased in 1932 by two more diesels. That brought our generating capacity to 3150 kw where it stands today. This is now handled by four diesels and five steam engines."

O'Connor: What was your approach to plant lubrication after taking over operation in early 1946?

Holz: First, I called in several of the oil suppliers and discussed the general problem. One oil company made a complete survey of the plant, coming up with specific recommendations covering all our lube needs. They suggested buying oil-storage tanks to take advantage of the oil price on bulk deliveries. On top of that, the number of individual lubricants were reduced. The oil company's lube engineer showed how we could reduce the variety of oils kept in stock. This was done by using one oil on a variety of equipment.

O'Connor: How many types lube oils do you now carry in volume?

Holz: We've only three; diesel, steam-engine and steam-cylinder oil. We have four 275-gal manifolded storage tanks to handle the diesel lube. Then there are two 275-gal tanks for storing the steam-engine oil. Steam-cylinder oil is delivered and stored in drums. Our bulk oil is delivered 500 gal at a time. Elimination of the oil drums for diesel and engine oil was a big step forward.

O'Connor: I noticed a battery of oil filters near the 8-cylinder diesel on the machine floor. Were they here when you took over?

. . . UP PRACTICAL OVERHAUL SCHEDULES. YEARLY OVERHAUL ESTABLISHED FOR ALL EQUIPMENT

ORIGINAL DC GENERATORS still putting out after more than half century. All dc electrical distribution throughout the University is at 120/240-v dc

Making full use of manufacturer's service facilities forms good part of Columbia's plant-management plan. Laboratory testing of feedwater, as well as lubricants, takes one more chore off the power engineer's shoulders. Results have been mighty good.

OLD EDISON BIPOLAR motor-generator set is in storage battery and fire-alarm circuits. Motor fed from 120-v dc while generator puts out dc at battery-volt level

54-Year-Old Steam-Diesel Power Plant

Holtz: No, but we did have a separate fuller's earth filter. This meant the oil had to be carried manually to the floor below, and then run through the filter. The bypass filters you saw were added later.

O'Connor: How often do you change oil-filter elements?

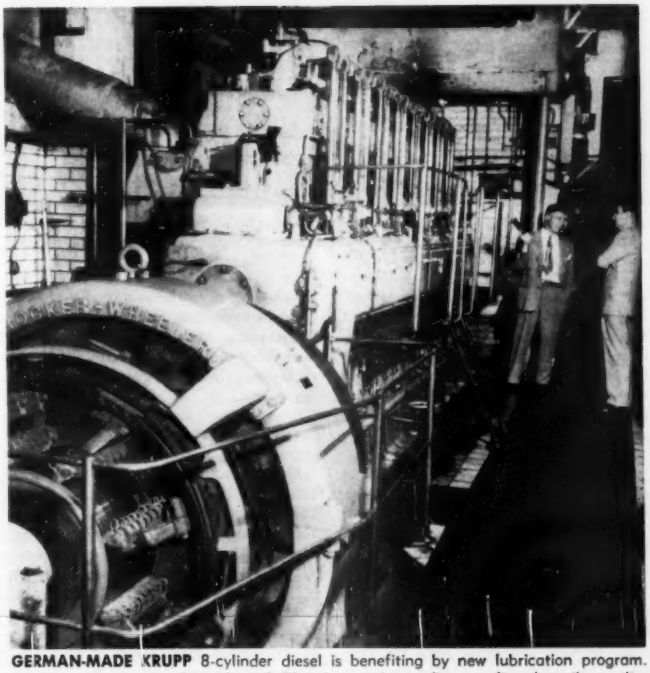
Holz: About every 400-600 hr of diesel operation. These filters operate on the bypass system. When the diesel starts, the lube oil circulates without benefit of filtering till a preset temperature is reached. At that predetermined point the filters cut in. We check the flow through these filters about twice a week.

O'Connor: Do you test your lube oil from time to time to spot when it should be replaced?

Holz: No. I've put all that in the hands of my oil supplier. They send their lubrication engineer around every so often to take samples. These are tested in their laboratory and a full report sent to me.

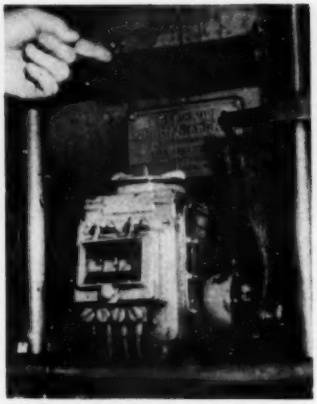
I feel the service oil suppliers render to engineers in small plants is invaluable. It's definitely taken a load off my shoulders.

O'Connor: Along with analyzing the lube program what definite steps

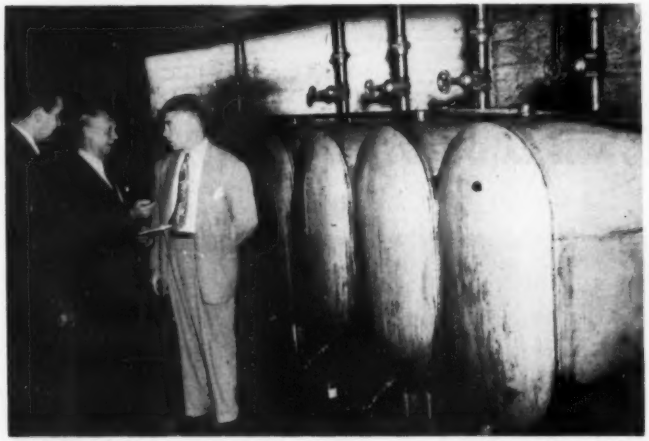


GERMAN-MADE KRUPP 8-cylinder diesel is benefiting by new lubrication program. Bearing wear is cut down by oil filtration and perodic sampling by oil supplier

MODERN OIL FILTERS on continuous bypass system replaced isolated fuller's earth unit. In old days lube oil had to be muscled periodically between diesel and filter



OIL-PROOF HOSE inserted at intervals in diesel-lube-oil lines simplifies cleaning



OIL-STORAGE TANKS replaced drums. A H Lowman *(left)*, W F Sinderhauf *(center)* of The Texas Co chat with Chief Holz before four 275-gal diesel-lube storage tanks

did you take on general maintenance?

Holz: First thing I did was set up a schedule for equipment overhaul. Now once a year each piece of equipment is taken apart. In the summer, when we need the diesels, we take the steam engines down. And in the winter, the diesels are overhauled.

O'Connor: Taking your diesels as an example, how far do you go in overhauling?

Holz: We strip the engine completely. And on alternate years we pull the cylinder liners and replace piston rings.

Typical overhaul calls for taking the rings off, disconnecting the rods, checking shaft, removing the main bearings and checking for wear. Then the fuel pumps are taken down. If they are worn we send them to the factory for repair.

Along with that we check fuel tips, exhaust and intake valves, springs, and oil galleries on the camshaft. In a nutshell we strip the engine, leaving only the casing.

O'Connor: How do you handle boiler maintenance?

Holz: Once again, it's on a yearly basis. All boilers are opened, washed and cleaned. And because of our top-notch feedwater-treatment program we have eliminated turbining the tubes. All they need now is washing.

I should add that the feedwater folks follow a plan similar to the oil supplier's. Every two weeks their engineer drops around for a general checkup. During the heating season he takes a water sample from each boiler and sends it through to their lab.

Part of their service plan includes analyzing our log sheets. They study these periodically and prepare written comments. If they think we are underfeeding or overfeeding a certain chemical they tell us so.

But coming back to the boilers again . . . every second year we completely overhaul the stokers. Grates are taken apart, rollers checked, all valves are checked along with flues and baffles.

O'Connor: How do you handle your routine overhaul on steam engines?

Holz: Here, too, we have been following an annual take-apart program. But experience shows wear has been so little that we are planning to extend the time between overhauls to every two years. But we still plan to check the main bearings, connecting rods, crank and links on the corliss gear since they are subject to the most wear.

Take that vertical engine over there! We took it apart last summer. Along with replacing packing and rings we took the links out and found half the bearings worn. We made new bearings, keyed the unit up, and cleaned out oil lines. We are careful not to overlook the throttle valve, governor, etc.

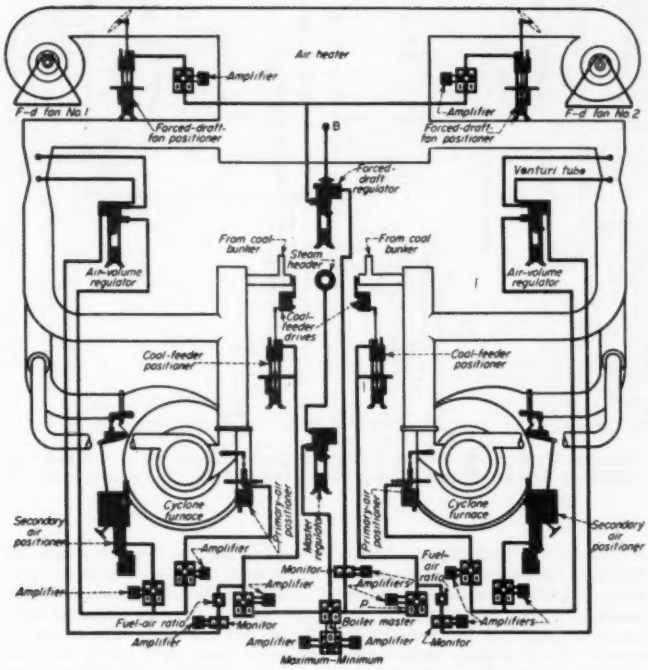
O'Connor: Have you any tangible proof that your general maintenance and lubrication program plan pays off?

Holz: Definitely yes. By checking with records of yesteryear I find there has been a marked reduction in breakdowns. As a result our 54-year-old plant is still perking away with a minimum of down time.

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

36—Automatic Combustion Control



1 High accuracy, fast speed of response, elimination of transmission lags and simplied control panels are some of the features of this electronic control

► ELECTRONICS HAS SOLVED many of our industrial control problems and is now doing a similar job in automatic combustion controls for large boilers. Increased centralization of automatic controls places responsibility on fewer operators and on the control system. Added to this, automatic-control problems are made more difficult by increased distances between the measurement points and control and the central control board.

Electronic Control. Transmitting the actuating impulses electronically from the master regulator to the power units has solved these problems in a system developed by Republic Flow Meters Co, under the guiding genius of Charley H Smoot, chief development engineer. In this system, basic-master, fuel-feed and air-flow regulators have not changed, but while regulators in the old system produced a change in air pressure, the new cause a change in voltage. The system operates on a null-balance principle of detection and electronic transmission of control signals to change the combustion rate in the furnace.

Fig. 1 shows the system applied to a large boiler fired by two cyclone furnaces. The system looks a little complicated, but if we study one piece at a time it unfolds easily. We will first study the different parts of the control. There are three basic units: master, power and air-volume.

Master regulator is shown in Fig. 2. Steam-header pressure connects to a metal bellows *B* and is balanced through weighbeam *W* by spring *S*.

Air under pressure comes in at *A* through an orifice *O* and is applied under diaphragm *D*. Upward pressure on *D* is balanced by spring S_1. Air to multiplying valve *V* leaks slowly to atmosphere. Weighbeam *W* connects to guide beam *GB*, to which multiplying-valve control *C* connects.

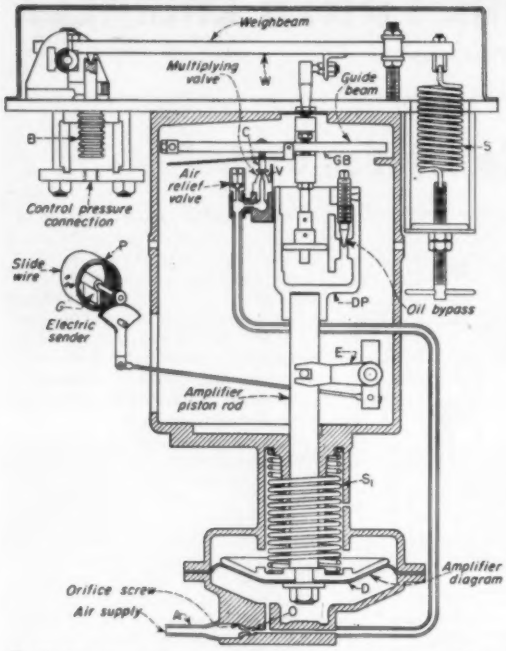
If steam pressure falls as on load increase, weighbeam *W* takes a slightly lower position. Control *C* also moves toward *V* to increase its throttling. As a result air pressure increases under diaphragm *D* and it starts pushing dashpot *DP* upward. This action slightly lifts guide beam *GB* and weighbeam *W* to reduce throttling of valve *V* and again put the system in balance. When diaphragm *D* moved dashpot *DP* upward, it also lifted connection *E*, which through a linkage moves contact *G* of slidewire *P*. This slidewire forms two legs of a wheatstone bridge, so when arm *G* moves it unbalances the bridge circuits. Unbalanced voltage of the bridge is the signal to the control system to supply more fuel and air to the furnace.

Position regulator. Fig. 3 is a power unit for damper or coal-feeder control. The master signal is amplified and fed into motor *M* to drive it. This motor moves arm G_1 in slidewire P_1 to balance the bridge circuits and stop the motor. The motor also moves pilot valve *PV* off neutral, say upward. Air is then admitted through the upper valve port around under the power piston, which starts moving up to open a damper or increase the coal feed.

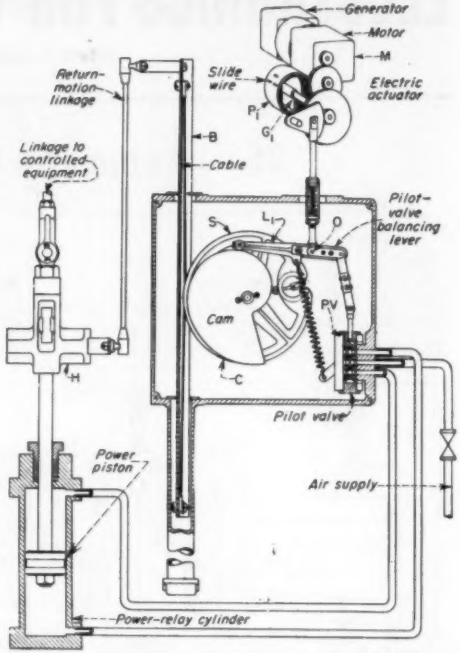
A crosshead *H* on the piston rod connects to bar *B*, which drives cam *C* through cables on sheave *S*. When the piston rod moves up, cam *C* turns clockwise to lift left-hand end of lever L_1 pivoted at *O*. Right-hand end of L_1 then goes down to restore pilot valve to its neutral position and stop the power unit when air flow or coal feed has been increased the correct amount.

Air-volume regulator is similar to the master, except its weighbeam is balanced by air-pressure differential across a diaphragm instead of steam pressure

MASTER AND POSITION REGULATORS WITH THEIR ELECTRIC ELEMENTS



2 Master steam-pressure regulator moves slider in electric sender to actuate position regulators in the control system



3 Position regulator or power unit for air or fuel-feed control is actuated by amplified signals of master regulator

against a spring. It has an electric actuator as in Fig. 3 and a sender as in Fig. 2. Later in this article we will say more about this regulator.

Control Panels. Let's return to Fig. 1 and study the control panels. All panels are similar to Fig. 6, except the one marked maximum-minimum. They have a knob at lower left-hand for switching from automatic to manual operation, or vice versa. When the left-hand knob is switched to manual, turning the right-hand one clockwise or counterclockwise, different part of the control equipment can be actuated. With this knob on the boiler master panel, boiler output can be controlled manually.

At top of panel are two voltmeters, one marked *Auto* and the other *Position*. *Auto* shows what signal has been sent. When this request has been satisfied, *Position* meter reads the same as *Auto*. As long as the two meters read alike the operator knows the equipment is doing what it has been told to do.

Between the two meters is a dial and knob connected to a slider on a slidewire. With this knob, adjustments can be made in the control while the boiler is under automatic control. For example, when preparing to take a boiler out of service, its load can be gradually reduced from the master panel. Also, when putting a boiler into service its load can be gradually increased. On the fuel-air ratio control panel the fuel-air ratio can be adjusted. In other words, these knobs on the different panels give the operator a wide range of flexibility in handling the boilers.

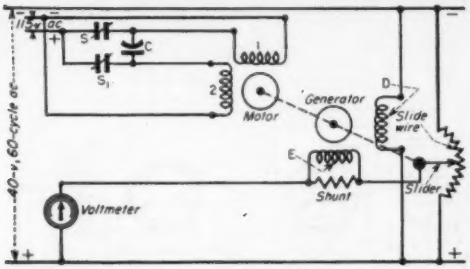
Maximum-Minimum Panel. Fig. 7 shows this panel. Knob and dial in lower left permit limiting the maximum boiler load to any desired value. On the right, the knob sets the control to prevent reducing the boiler load to an unsafe value. When burning pulverized coal, the fire may go out if the firing rate is reduced below a safe minimum. This will vary with the number of burners in use. With two burners, safe operation may be 30% of boiler rating and above, so the pointer is turned to 3. If one burner is shut off, the boiler may be operated safely at 20% rating, and the pointer is set at 2.

With the knob at top of panel the maximum-minimum control can be connected into the loading circuit or by-passed. When the two green lights *G* are lighted, they show the boiler operating within the set maximum and minimum ratings. If minimum green light *G* goes out and minimum red lamp *R* lights, it shows the operator that the boiler is operating at the minimum safe rating. On the other side of the panel if the green light *G* goes out and the red lights, the operator knows that the boiler is operating at its maximum set rating.

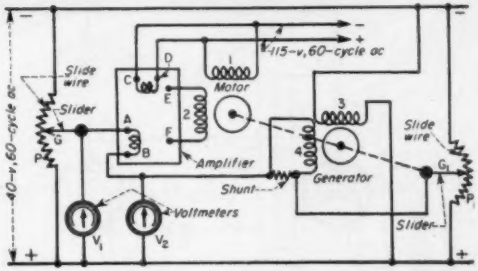
Forced-Draft Regulator. In Fig. 1 each burner has its complete set of controls, so both sides of the drawing are alike. The forced-draft regulator is common to both burners. This regulator positions the forced-draft dampers to provide ample air pressure at all boiler loads and at the same time loads the forced-draft fans economically. Other than this the regulator has no control of the firing rate.

Assume that steam pressure drops slightly indicating an increase in load. This decrease in pressure causes the master regulator to move the slider in the slidewire, Fig. 2. Moving the slider unbalances a bridge circuit and a voltage signal is sent through the

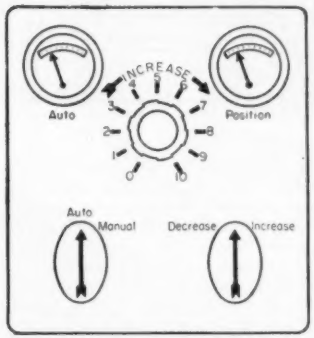
SIMPLIFIED MANUAL AND AUTOMATIC-CONTROL DIAGRAMS AND PANELS



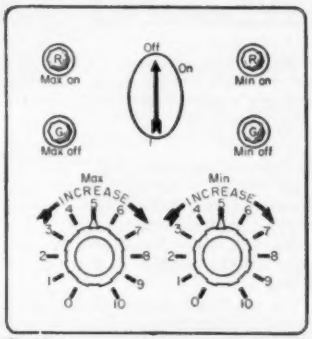
4 Manual control uses a 3-position switch to connect a capacitor in either of the two windings of the 2-phase motor



5 For automatic control, sender slidewire is on the master; receiving slidewire is in actuator on the position regulator



6 Front view of the manual-automatic subpanel with separate ratio control



7 Maximum-minimum control subpanel; from it boiler load can be limited

boiler master and is amplified and goes to an electric actuator in the forced-draft regulator. This actuator is similar to that in Fig. 3. The motor unbalances the regulator to call for more forced-draft pressure. When the regulator moves it shifts the slider in a slidewire as in Fig. 2 to signal the forced-draft fan positioners to open the dampers a given amount. Electric actuators on these damper positioners are similar to Fig. 3. The amplified signal causes the electric-actuator motors to open the air pilot valves. As the power units open the dampers they also close the pilot valves when the dampers come to the position called for by the signal.

When the dampers open, air pressure increases in the breeching and is applied through a connection at *B* to a diaphragm on top of the forced-draft regulator. Increasing the air pressure puts the regulator back in neutral when the signal it received has been correctly answered.

Coal-Feed and Air-Volume. Another signal goes from the boiler master through a panel *P* and amplifier to the coal-feeder positioner, to increase the coal feed, in proportion to the master-regulator signal. The signal sent out by panel *P* and its amplifier also goes to an electric actuator in the air-volume regulator. The actuator unbalances the regulator in proportion to the signal and sends a signal to the primary- and secondary-air damper positioners for more air. This increase in air flow is measured by the venturi tube, which increases the differential pressure on the diaphragm of the air-volume control.

When air flow increases the right amount, air-pressure differential balances the regulator and holds the air volume correct to the burners. If pressure changes in either the forced-draft air duct or the furnace, air flow changes. This is detected by the venturi tube and diaphragm in the regulator. Unbalancing the regulator causes it to signal the primary- and secondary-air damper positioners to correct air flow to the amount called for by the signal to the electric actuator.

Control units for the left-hand burner operate like those on the right-hand slide. So what has been said about one applies to the other. Each part of the control was explained separately, but they all respond simultaneously to the master-regulator's signal for more or less fuel and air in the correct ratio.

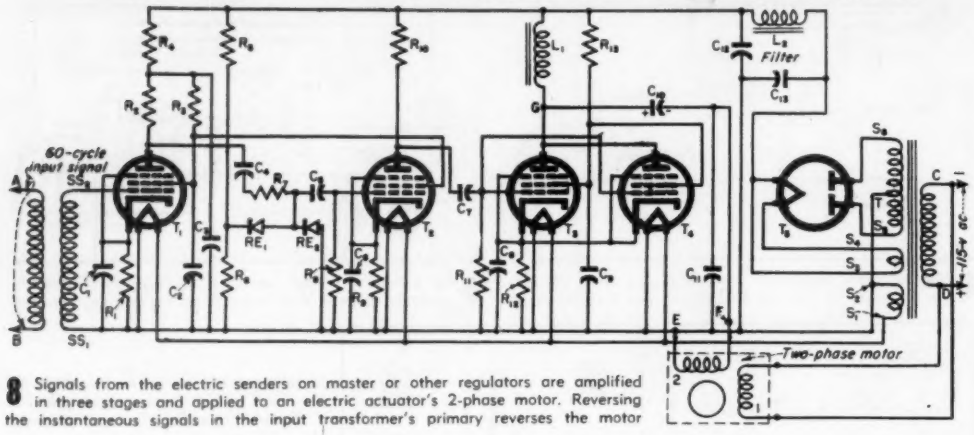
Electric Actuator. Now let us study how the electric equipment operates. An electric actuator consists of a 2-phase squirrel-cage reversible 1/200-hp motor connected by a gear train to a receiving slidewire. This slidewire forms two legs of a wheatstone bridge. Mounted on the shaft with the motor is a feedback generator that prevents overrun or hunting of the control system even at high rates of response.

Manual Control. Fig. 4 shows connections for one of the actuating units during manual control. The motor operates from a 110-v single-phase power source. On the bridge-control circuits, 40-v 60-cycle ac is used. A capacitor gives the necessary 90-deg phase relation of the currents in the motor windings for 2-phase operation. Switches *S* and S_1 are closed so both windings are energized for dynamic braking. The motor is so designed that it will not overheat when energized and stalled.

Opening switch S_1 leaves motor winding No. 1 across the 115-v ac line and puts capacitor *C* in series with winding No. 2 for one direction of operation. Closing switch S_1 and opening *S* connects winding No. 2 directly to the line and winding No. 1 through the capacitor, to reverse the motor. As the motor rotates it drives the feedback generator and moves the slide on the slidewire. Moving the slider changes the reading on the voltmeter to show the operator that the motor is making the adjustment called for.

Automatic Control. Fig. 5 is a simplified diagram of an automatic control unit. To this is connected a primary slidewire *P*, an amplifier and a voltmeter in addition to the equipment in Fig. 4. Slidewires *P* and P_1 form a wheatstone bridge. Slidewire *P* could be connected to the master regulator as in Fig. 2. When both sliders are in the

DIAGRAM OF CONTROL-SYSTEM AMPLIFIER AND ELECTRIC ACTUATOR MOTOR



8 Signals from the electric senders on master or other regulators are amplified in three stages and applied to an electric actuator's 2-phase motor. Reversing the instantaneous signals in the input transformer's primary reverses the motor

same position as in Fig. 5 they are at equal-voltage points, the bridge is in balance, and no current flows between the sliders.

When the master regulator moves it shifts slider G and P, as explained for Fig. 2. Moving slider G unbalances the bridge circuits and sends a signal to the amplifier for a change in the firing rate. At the instant we are considering, assume the top 40-v and 115-v ac lines are minus and the bottom lines plus, as shown. On slidewire P if we move slider G up it will be at a higher voltage than G_1. A current then flows from — line to G, from A to B through the amplifier, the shunt and generator winding No. 4, to G_1 and to + line.

We see that with the line polarity shown when slider G is moved up on P, current flows down through input transformer primary AB. At the same time assume current flows down through motor winding No. 2. Moving G down on P reverses current flow in the input transformer and motor winding No. 2. Here note that, at any instant, polarity of the input signal can be reversed with respect to that of the line by moving slider G up or down on slidewire P. This makes it possible to reverse the signal to the amplifier at a given instant to reverse the motor's rotation, as we will find when we study the amplifier.

Remember that the two power sources are ac from the same supply and their polarity is continually changing. But once a relation is established between signal and line polarity, it holds until the signal is answered.

Amplifier Diagram. Fig. 8 shows the wiring diagram of the amplifier. On the left is the input transformer connected to terminals A and B, and on the right is the power transformer connected to C and D, Fig. 5. No. 1 motor winding connects across the 115-v power line, while No. 2 winding connects into the amplifier to E and F, as in Fig. 5.

The amplifier has three stages, tubes T_1 and T_2 being in the first and second respectively. Tubes T_3 and T_4 are in parallel and serve as the third stage of the amplifier and as power tubes. Tube T_5 is a full-wave rectifier, its output being filtered by reactor L_2 and capacitors C_{12} and C_{13}. Secondary S_5S_4 heats the cathode of T_5 and S_3S_2 heats cathodes of tubes T_1 to T_4 in parallel.

When there is no signal to the input transformer the amplifying tubes are not biased and dc flows through them from tap T on the power transformer back through the filter and tube T_5 to transformer secondary S_5S_4.

Assume 115-v line polarity shown. Current then flows up through motor winding No. 1. A voltage is also applied from T through motor winding No. 2, capacitor C_{11}, reactor L_1 through the filter to the T_5 and the transformer. Capacitor C_{11} will not pass dc but is charged to the polarity shown.

Motor Operation. Assume that in Fig. 5 line polarity is as shown and slider G is moved up on P. This causes a signal current from A to B in the input transformer's primary. Taking this as the instant condition in Fig. 8, current flowing from A to B induces a voltage in the opposite direction in secondary SS_1SS_2. This voltage puts a minus bias on the grid of T_1 from SS_2, grid to cathode, resistor R_1 to SS_1.

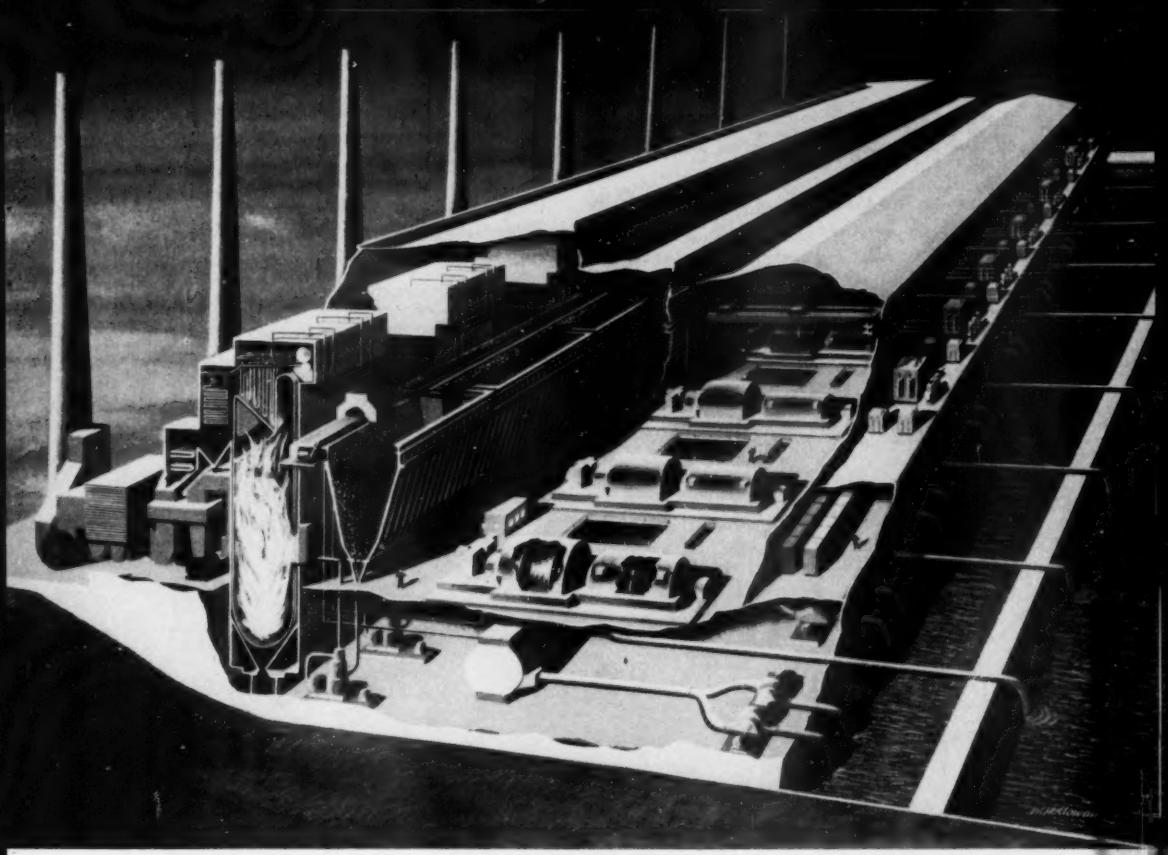
After being amplified through tube T_2 this bias is applied to tubes T_3 and T_4 to decrease current flow through them. When current flow decreases, voltage drops at G and reactor L_1 has a voltage induced in it that tends to keep current flowing. As a result, current flows from E to F through No. 2 motor, winding, capacitor C_{10}, reactor L_1 through the filter, tube T_5, to the transformer. When circuit polarities reverse, current flows down through No. 1 motor winding and up through the input transformer's primary winding.

Voltage induced in secondary winding is down and puts a plus bias on tube T_1, from SS_1, through R_1, cathode to grid of T_1 and SS_2. This bias is amplified and applied to tubes T_3 and T_4 to cause an increase in current flow through them. When the current tends to increase through the reactor L_1, a voltage is induced in it that opposes this change, and the voltage rises at G. This voltage is in series with that of capacitor C_{10} and it discharges from F to E through No. 2 motor winding, tubes T_3 and T_4 to the capacitor.

Two things happen in this operation. Polarity of the capacitor is reversed and the capacitor causes the current in No. 2 winding to lead the voltage by about 90 deg. The latter gives about 90-deg current phase displacement in windings No. 1 and 2 of the motor for 2-phase operation. When the polarity of the lines again reverses, the signal to the input transformer reverses and tubes T_3 and T_4 again have a minus bias to reduce current flow through them. Then the cycle of events previously explained repeats, the motor rotating in one direction.

Motor Rotation Reversed. If the slider, Fig. 5, is moved down when line

(*Continued on page 214*)



SECTION OF ULTIMATE STATION that will house eight 125,000-kw units arranged on unit system, one boiler per turbine

Steam Giant Rises on Great Lakes

Cleveland Electric Illuminating Co builds Eastlake Station designed for ultimate capacity of 1,000,000 kw. First two units will use reheat, arranged on unit system, one boiler per turbine. Boilers will run with forced steam-water circulation

► AT EASTLAKE VILLAGE on the shores of Lake Erie, about 20 miles east of downtown Cleveland, the Cleveland Electric Illuminating Co will soon break ground to erect a record-size steam-electric station. The planned ultimate capacity of 1,000,000 kw more than equals its present system capacity of 984,000 kw. First section to be built will have two 125,000-kw units, the first to go into operation in 1952, the second in 1953.

Sketch above shows there will be two principal operating levels with central control rooms for the main units of equipment. Boilers will use semi-outdoor construction. Forced-draft and induced-draft fans, precipitators and air heaters will stand outdoors. To keep construction costs down, all tunnels, both for water and electric cables, have been eliminated. Circulating water will be brought to the plant by an open channel, perpendicular to the lake front, running length of plant. A parallel channel takes water back to the lake.

Main transformers, direct connected to main generators, stand directly outside the station wall. Main generators produce at 18,000 v.

To achieve high operating economy, main steam conditions will be 1800 psig and 1050 F with reheat to 1000 F. Forced circulation within the boilers will help to minimize physical size.

A modern coal-handling system will use conveyors, bulldozers and scrapers. An area of 800x2500 ft will be used to store 1,500,000 tons of coal.

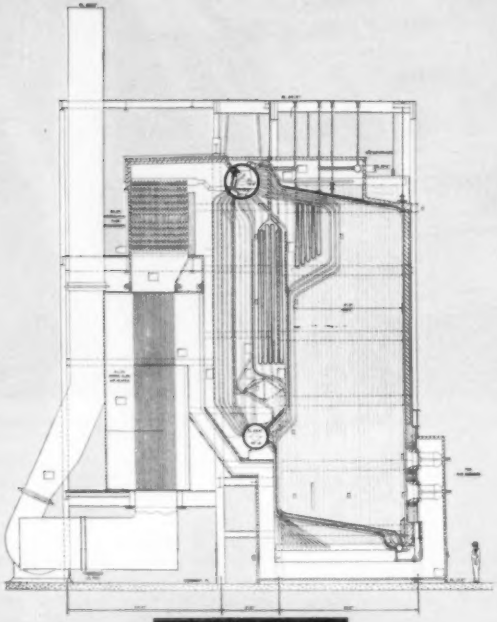
To reduce extent of piping and electrical equipment and to simplify operation under emergency conditions, the first two units will run entirely independent of each other. There will be no main interconnections between units. Steam and electrical controls, however, will be centralized for convenience and operating efficiency.

A switch house will not be needed at Eastlake Station because generator output will be sent direct to the 132,000-v transmission system through the outdoor stepup transformers. These features all represent a modern departure for the Cleveland Electric from their former central-station design practice.

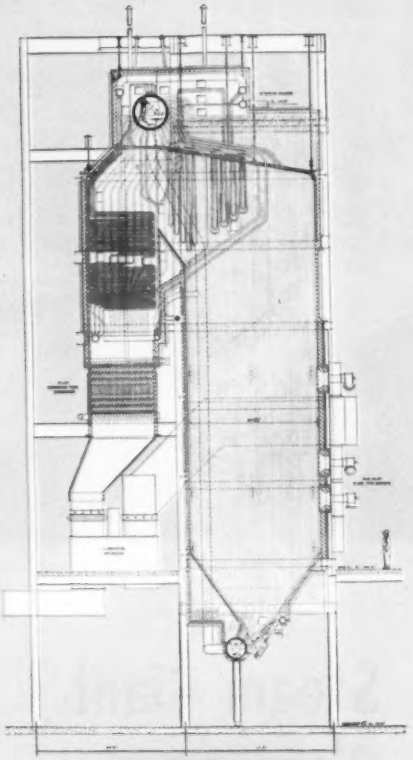
Typical RILEY High Pressure

Here are a few typical layouts of Riley high pressure, high temperature steam generating units. Riley units are establishing enviable records, not only for high efficiency and economy but for long continuous periods of trouble-free operation.

Because of unusual results from existing Riley installations Riley has attained a position among the leaders of the boiler industry. Many purchasers of steam generating and fuel burning equipment have found it pays to ask Riley for a proposal.



450,000 LBS./HR.
1450 LBS.–950°F.



400,000 LBS./HR.
1475 LBS.–955°F.

Dow Chemical Co., Freeport, Texas
The Texas division of Dow Chemical installed their first high pressure Riley units in 1942. They recently ordered four additional units. Ten 300,000 lbs./hr. Riley units are also installed.
Stone & Webster Engineering Co., Engineers

South Carolina Electric & Gas Co., Charleston, S. Carolina
This is the third Riley unit for South Carolina Electric and Gas Co. They installed their first Riley unit in 1947 and their second Riley unit in 1950.
Gilbert Associates, Engineers

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

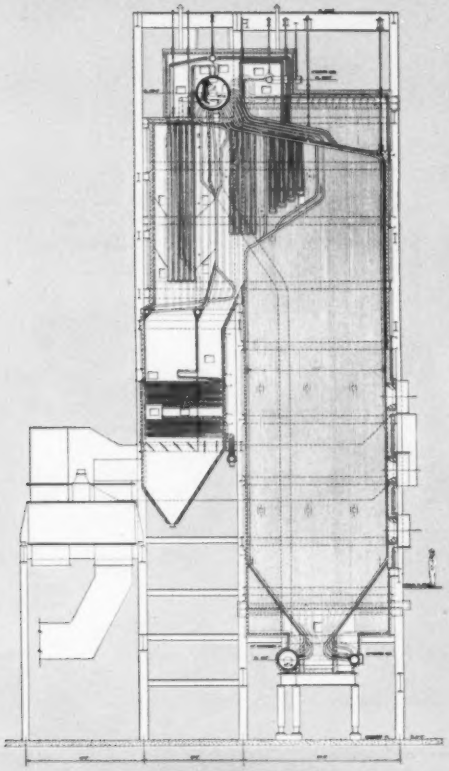
Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Atlanta New Orleans Memphis St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

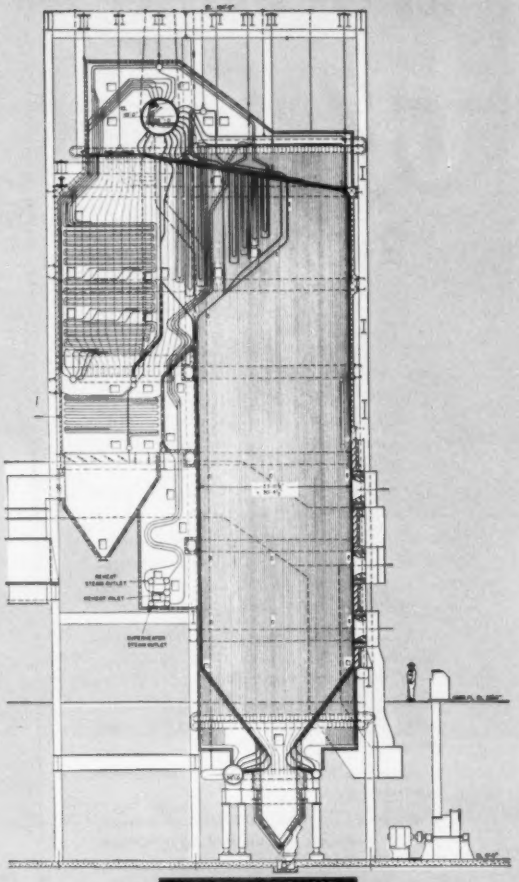
Steam Generating Installations

Ask a Riley User — he will assure you

**** You Can Rely on Riley***



620,000 LBS./HR.
1500 LBS.–955°F.



575,000 LBS./HR.
1700 LBS. 1000°F.
1000°F.–REHEAT

Utah Power & Light Co., Unit No. 1, Salt Lake City, Utah
For the first unit at their New Jordan Station, Utah Power and Light Co. installed this 620,000 lbs./hr. Riley unit. In 1948 they installed their first Riley unit at their Orem Station.
Bechtel Corp., Engineers

Utah Power & Light Co., Unit No. 2, Salt Lake City, Utah
Utah Power and Light Co. selected this 575,000 lbs./hr. Riley reheat unit as the second unit at Jordan Station. Their subsidiary, Western Colorado Power, also uses a Riley unit at Montrose, Colorado.
Bechtel Corp., Engineers

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

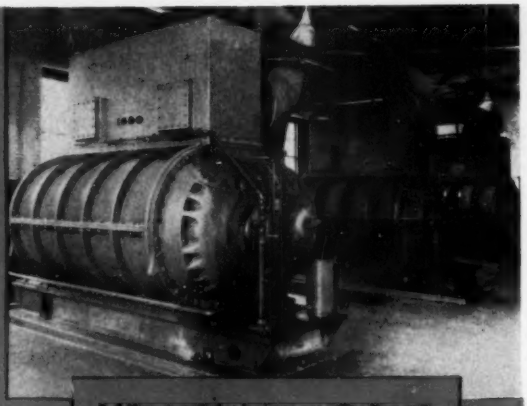
YOU CAN ALWAYS trust R-C METERS

If you're measuring gas for production processes, you can't take any chances on quantities. If you are buying or selling it, you need cash register accuracy. You want equal precision for departmental cost accounting.

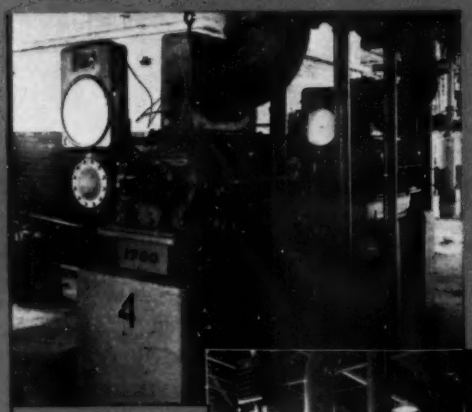
The permanent accuracy of R-C Positive Displacement Meters has long been proved for all these purposes by manufacturers and utilities which buy, sell and use gas. Four important reasons account for this unvarying reliability:

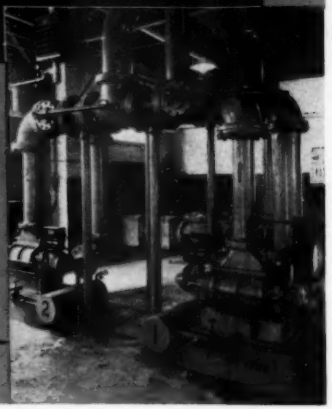
1. Accuracy is not affected by variations in specific gravity, rate of flow, pulsation, moisture, impurities or uncontrollable factors.
2. Accuracy is not subject to adjustment of meter or recorder by operators or other persons.
3. Accuracy is not affected by reasonable overloads.
4. Accuracy is permanent because measuring chambers are surrounded by precision-machined, cast iron surfaces.

The 31 standard sizes of R-C Meters give capacities from 4,000 cfh to 1,000,000 cfh. They are extremely compact, permitting installation in cramped spaces. Indicating and recording instruments are available for all types. For whatever purposes you measure gas, you can permanently depend on R-C Meters. Ask for Bulletin 40-B-14 or write us your specific problem.



R-C Meter installation for large gas utility. New unit, in front, has capacity of 1,000,000 cfh. Two older meters, in background, have been in use for years.

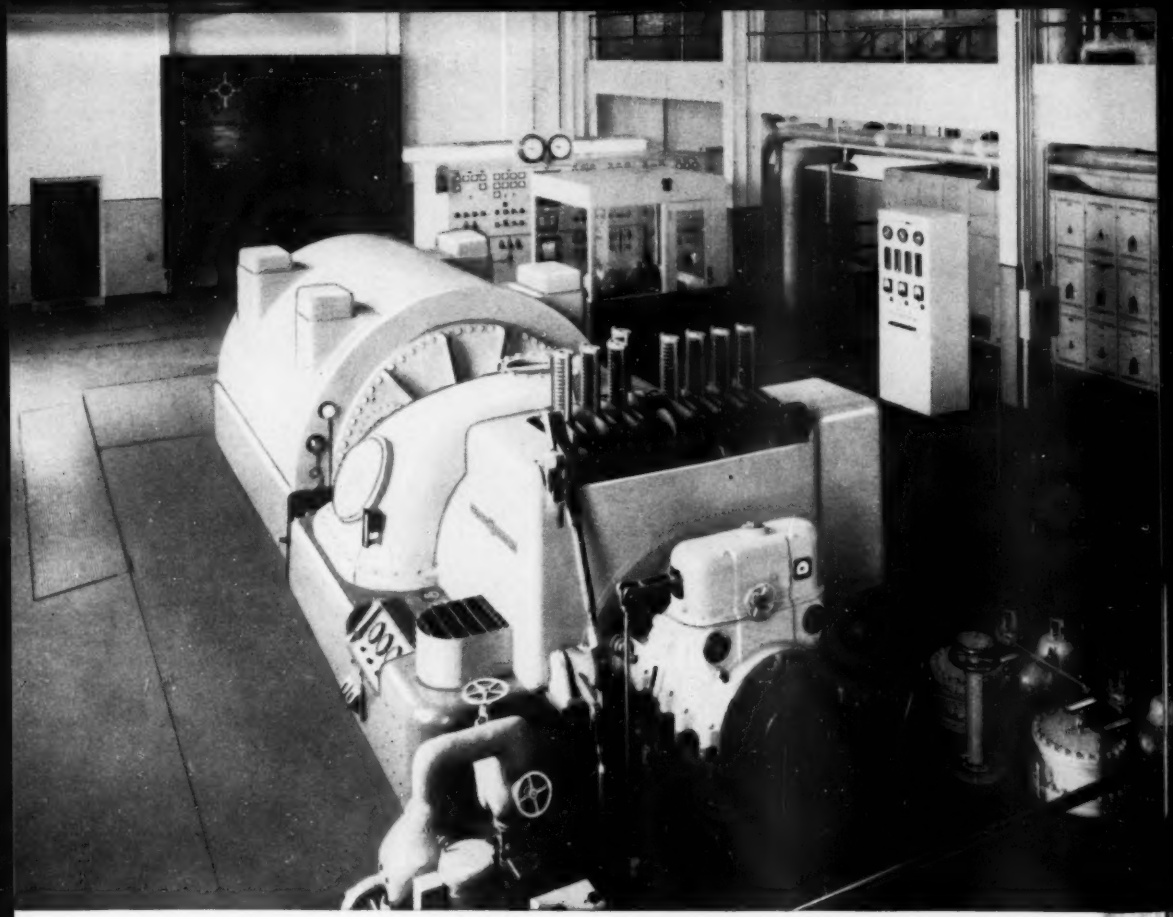




Part of an installation of nine R-C Meters in large processing plant, measuring acetylene gas sold to nearby manufacturers. They also use R-C Meters on receiving ends. Capacities range from 2,000 cfh to 130,000 cfh.

ROOTS-CONNERSVILLE BLOWER CORPORATION
510 Powell Ave.,
Connersville, Indiana

ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES



New turbine is slated for trouble-free life

IN 1949 when this 21,000-KW turbine was put in operation in a midwest power company, officials saw no problem in keeping maintenance at a rock-bottom low. Experience covering 16 years' operation convinced them that they had the answer—NONPAREIL Turbine Oil. They had already put NONPAREIL into three 5,000-KW units—in 1933, in 1935, and in 1940, respectively.

To this day the oil in these units has not been changed, yet there have been no oil-deterioration troubles, no deposit troubles, no high-acidity troubles. In fact oil neutralization numbers have remained below 0.10 mg. KOH/gm.

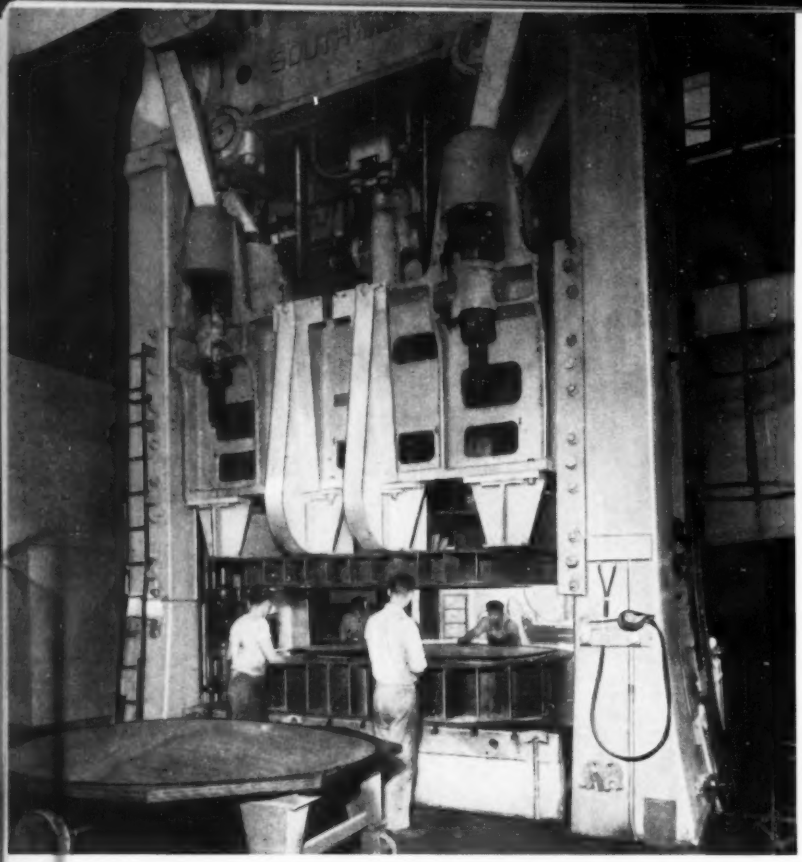
Consider that record as applied to minimizing your maintenance and costs . . . no oil replacements, no removal of oil for treating, no downtime for cleaning oil systems that stay entirely clean. Moreover, there is no time limit on these benefits. You will receive with each fill of oil a written guarantee that NONPAREIL Turbine Oil will last as long as your turbine, and that its neutralization number will stay below 0.15 mg. KOH/gm.

Have a Standard Oil lubrication specialist show you service records that, in each case, cover 21 years of continuous operation on NONPAREIL Turbine Oil. Ask him for case histories that show how NONPAREIL has reduced utility lubrication costs as much as 68%. You can reach a lubrication specialist through your local Standard Oil Company (Indiana) office. Or, if you wish, write:

Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 80, Illinois.

NONPAREIL
TRADE MARK
Turbine Oil

STANDARD OIL COMPANY (INDIANA) STANDARD



Answer to a "Pressing" need . . .

TROUBLE-FREE hydraulic operation of a new toggle press was particularly important to the Brown Steel Tank Company of Minneapolis. Such operation would keep costly inspections of the hydraulic unit at a minimum—production at a maximum.

A Standard Oil lubrication specialist was called in. He recommended STANOIL Industrial Oil for this vital hydraulic job. During three years of hard, continuous service (hydraulic unit operates 2000 P.S.I. maximum), STANOIL has stayed on the job and has permitted efficient hydraulic operation. It has not been necessary to inspect the hydraulic unit in all of this time. A recent sample test showed the hydraulic oil to be in excellent condition.

STANOIL will give long oil life and trouble-free service in a wide variety of equipment: speed reducers, head stock gears, auxiliary turbines, compressors, as well as hydraulic systems. STANOIL is fortified to combat rust and corrosion.

STANOIL
TRADE MARK
Industrial Oil

Your nearby Standard Oil lubrication specialist is ready to explain how your plant may obtain maximum benefits from STANOIL and other high-quality petroleum products.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for his prompt attention.

What's YOUR problem?

Meet C. K. Olsen, lubrication specialist in Standard Oil's Minneapolis office.

Consulted by the Brown Steel Tank Company, he recommended STANOIL Industrial Oil as the answer to their needs. As a result, he helped the company realize significant savings in operating costs.

Standard Oil lubrication specialists are located throughout the Midwest. Just phone or address a card to the nearest Standard Oil Company (Indiana) office for the services of the specially trained lubrication specialist near your plant.

With his help, find out how many different oils in your plant can be replaced by STANOIL Industrial Oil on such applications as:

Air compressors . . . no sticking or clogging of valves, less oil consumption in splash or circulating systems.

Speed reducers . . . less wear of gears and bearings during frequent cold starts or prolonged high-temperature operation.

Steam turbines . . . freedom from emulsions and sludge, fewer oil changes necessary.

Ring-oiled bearings . . . rings function immediately on starting, less bearing wear.

Circulating and bath systems . . . one oil for a wide variety of jobs.

STANDARD OIL COMPANY (INDIANA)

PLANT OPERATION and MAINTENANCE

SECTION OF POWER COMBINED WITH OPERATING ENGINEER

Welcome to All OE Readers

I AM HANGING out the old sign in this new clubhouse so that you thousands of *OE* readers will know where you can park your hats and keep right on meeting the same engineering cronies, hard-bitten editors and windy Surfaceblows you have known through the pages of *Operating Engineer*.

By this time you probably understand how you happen to be in this home. But, just in case you missed my announcement in March *OE*, and the letter I mailed out, let me say that *Operating Engineer* has been incorporated—lock, stock and barrel—in this new and greatly expanded POWER magazine. Nothing has been left out. Nothing much has been changed, except that *Operating Engineer* magazine now becomes this big *Plant Operation and Maintenance* section of the bigger POWER.

In the pages that follow you will find every kind of article, and every department, you knew in *OE*. All this is kept together, for your convenience, in the *PO&M* section, except New Equipment and New Bulletins, which now fit more logically in Part 3, our *Reader Service* section. There you will find much of value—Power News, Bookshelf and Technical Briefs—all from POWER and all new to you *OE* readers.

In addition, POWER now brings you many professionally slanted, technical articles in the front section devoted to the *Engineering and Management* side of your power job. This is just the kind of material so many of you have been looking for in borrowed copies of POWER. Getting this top-level technical and planning service will no longer be a problem to you. And many of your *OE* shipmates will now have their first opportunity to profit by these dependable presentations of engineering and managerial information.

And remember that this cross traffic of readers, from one section of the new POWER to another works both ways. For many POWER readers have been looking for something to round out the technical service they have valued so highly. To an increasing degree they have borrowed copies of *OE* to keep step with you in the practical know-how of everyday maintenance and operation. Now they have the same *OE* you know—every subject section and every department—the same practical slant and the same plain writing.

So the road is now clear all up and down the line for every power engineer to be as "practical" and as "professional" as he may wish in the on-the-job reading that will help him shape his own future. We believe many thousands will want to go the whole way in search of all-round power-engineering ability and the personal rewards that go with it.

Since April POWER is now in your hands, and is typical of what you will be getting every month from now on, I won't take more of your time talking about it. Thumb through the whole book to get your bearings. Read whatever strikes your interest. Then judge for yourself how well the new magazine is serving you.

If you have any comments, shoot them in.

Phil Swain

PREVENTIVE 'KNOW HOW' SAVES MONEY AND KEEPS BUSY PLANTS RUNNING

10 TESTED MAINTENANCE

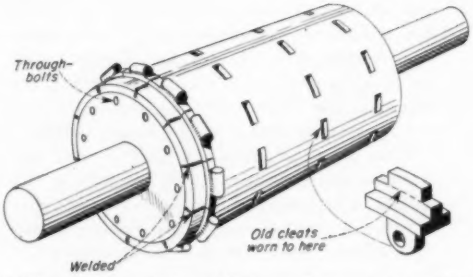
1—GRINDER REPAIR . . . Welding in place cut big repair bill

► ASHES COLLECT in a pit under the furnace and are pulled only on the midnight to 8 am shift. Then ashes are sluiced through a trough into a clinker grinder and finally pumped to a tank where water is drained off.

Cleats on clinker grinder were worn down almost to hub. But it's a good week's work to remove grinder, replace it with a spare, and then burn off old cleats and weld new ones on. So we welded 2-in. pieces of ¾-in. stainless-steel round stock on top of old worn cleats. We did this on day watch while grinder was idle and without taking them out of bearings. The welder kept busy and there was no holdup in production.

We didn't know the exact material in grinding cleats, but used stainless-steel rod. Reason was that when metal was held against grinding wheel, stainless steel gave off sparks resembling those of cleats. Our homemade cleats have been going strong for about four months now and are holding up fine.

J R SEARS *New York City*



1 Worn grinder cleats repaired on the spot by welding

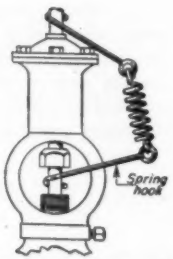
2—SPRING HOOK . . . Simple tool holds gland out of way

► EVER TRY to pack a hot valve in a hurry and have the hot packing gland keep sliding down against your fingers? I finally got tired of burning and skinning my hands. That's when I made spring hook shown here.

It's two simple hooks made of copper so they won't scratch valve stems. Eye on end of each hook fastens to a spring. When packing pressure regulators, governors, valves, etc, that are in a vertical position, just hook one end around the stem over the stuffing box and the other end to the valve wheel or the screw on the bonnet.

This simple gadget is worth its weight in gold. Every plant should have one. It's saved me a lot of cussing, to say nothing of time.

H C ULRICH *L. A., Calif.*

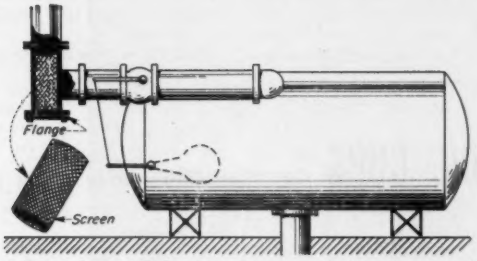


2 Hook holds up gland while packing

FOR PEAK OUTPUT

HINTS

3—SCREENS . . . How they save maintenance



3 Screen keeps all foreign matter out of deaerator control

► THERE ARE MANY places where a screen inside a line saves hours of work. We had continual trouble with deaerator control valve. Pieces of rubber valve discs were breaking off in vacuum pumps. They carried to surge tanks, then dropped down supply pipe and filled control valve. This is dangerous on fast-steaming, low-water-volume, water-tube boilers in our plant.

We made close-fitting bucket-type screen of heavy-mesh screening. This lets water by but holds back foreign pieces. To clean, we simply remove lower flange, take out and empty screen.

I have used screens to keep dirt out of a fire pump and even a well pump where sand shredded the packing. Again to keep string out of a water meter.

E J DUFF *Aurora, Colo.*

4—ONE BOLT COUPLING . . . Removing old and making new quickly

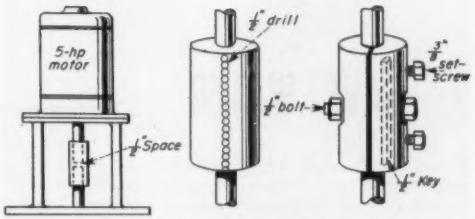
► WHEN THE 4-hp vertical motor running the agitator on a brine tank burned out, it was hard to remove. Reason was the cast-iron sleeve coupling, connecting motor and agitator shafts were tightly frozen.

Since we could re-use coupling, we took it out by drilling $\frac{3}{8}$-in. holes on opposite sides. Then we split weakened coupling in halves with a hammer and chisel.

I intended (when replacement motor was mounted) to put removed split coupling back in service and hold in place on shafts by two "U" bolts. But the $\frac{1}{2}$-in. space between shafts gave us another idea. Now we have a "one bolt coupling."

We placed a piece of 3-in. dia. x 6-in. long cold-roll steel in the lathe and bored a $1\frac{3}{8}$-in. hole to fit shafts. We then split it longitudinally in a milling machine with a $\frac{1}{8}$-in. cutter. Then milled a $\frac{3}{8}$-in. keyway in one half. We drilled holes in keyway slot for $\frac{3}{8}$-in. setscrews and a $\frac{1}{2}$-in. hole in center of each coupling half. The $\frac{1}{2}$-in. holes were faced on outside to provide a flat surface for bolt head and unit.

Assembly was fast since it meant placing $\frac{3}{8}$-in. key stock



4 New coupling solves the problem of a tough removing job

$2\frac{3}{4}$-in. long in shaft ends, bolting the coupling in place by the central $\frac{1}{2}$-in. x $3\frac{1}{2}$-in. finished bolt, then tightening set screws. Next we placed guard around open place on motor mount. This coupling is not only easy to remove, but also works very well.

FRANK COWAN *Perry, Iowa*

5—REFRIGERATION PIPING . . . $$$ cut from piping upkeep

► BETWEEN 1915 and 1925, I installed over 400,000 lineal feet of 2-in. direct-expansion standard black-steel piping. I built one large ice store in 1916 and put in 18,000 ft of pipe still in service.

Some engineers object to using galvanized pipe for ammonia work, but I have used $1\frac{1}{4}$-in. standard galvanized pipe in double-pipe ammonia condensers without any bad results. Reason is there's little air in system and internal surfaces of ammonia piping are usually coated with a film of oil. Ammonia has little effect on zinc in galvanizing.

If installing brine piping, which is later to be used for ammonia, take these precautions, whether using sodium or calcium brine: Treat brine to prevent corrosion. For every 1,000 cu ft of brine in system, add 125 lb of sodium bichromate and 25 lb of caustic soda. The caustic soda converts the bichromate into neutral chromate. Use bichromate

(Continued on next page)

instead of normal chromate because it's far less expensive.

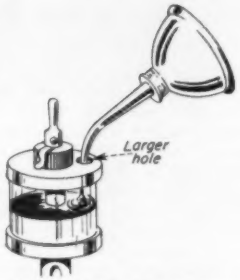
If brine is highly alkaline, you won't need to add full amount of caustic soda. But the pH should be adjusted between 7.5 and 8.5 for best results. If proper treatment is maintained, piping will stay in perfect condition for years and can be converted to ammonia (direct expansion) at any time simply by flushing out coils.

CAUTION! Avoid getting chromate on hands or face. There have been cases where chrome itch developed from careless handling. Dissolve chromate in an old drum with caustic, then pump into system. Always wear rubber gloves.

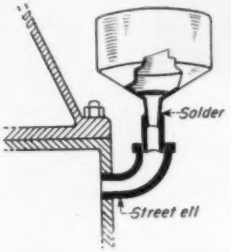
H C WELCH *Baldwin, N. Y.*

6—OIL CUPS . . . Can filling save costly time and oil?

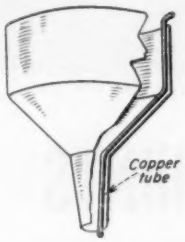
PLUGGED VENT from tight-fitting oil-can spout in oil-cup hole won't allow air to escape fast enough. That slows down filling oil cups and wastes oil besides. Waste adds up in big plant of many oilcups.



LARGER HOLE stops all trouble. Drill out hole large enough to make plenty room around can's spout, but keep hole covered when not filling. Be sure to remove drill chips from cup before using.



FUNNEL in filling line gives same trouble. Because oil runs in faster than air escapes, oil bubbles around spout. Solder short nipple to spout and screw snugly into a street-ell. It's worth trouble to change.



BLOWING-OUT effect from bubbles can be stopped by soldering small copper tube inside funnel. Then air is displaced up through funnel and out through the oil working downward in funnel.

W B KENNEDY *McCool, Miss.*

7—SAVE WATER . . . Wrong piping wasted 40,000 gallons a day

► OUR PLANT HAD TROUBLE keeping enough water in return tank to supply our six 563-hp boilers. And that was with cooling water returning from six compressor jackets. Also two heat exchangers discharged to the tank, besides the soft water makeup. This makeup returned through a float-controlled valve. In addition, all possible condensate returned from various parts of the building.

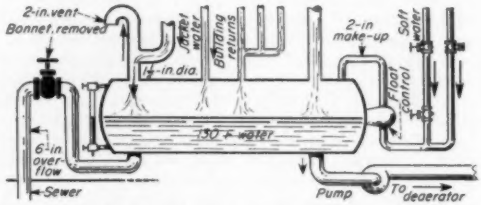
Even with the 2-in. makeup valve wide open, we couldn't always keep the level up in the boilers. At times the 2-in. hand valve had to be opened to supply more water.

One evening when the level in boiler gage glasses wouldn't come up, the shift engineer asked me for help. That part of the plant wasn't my responsibility, so I had to do a little exploring. I removed the valve bonnet from the 6-in. overflow line and found it full of water, sketch.

But removing that bonnet released a cloud of steam and air. I checked the overflow line. It was over 3 ft above the normal water level shown in gage glass. That meant there was a pressure of 1½ psi on top of the water in tank.

With the vapor and air releasing through the removed bonnet, the water rose quickly in the gage glass. That brought up a question. Why didn't the 3-in. vent remove that back pressure of vapor and air? Surely it was large enough.

I found the answer when I checked the vent on the tank. It had an 1½-in. line piped into it. A further check showed there was a steady stream of water from that line bucking the vapors trying to get out the vent. The maintenance gang removed the line piped into the vent next day.



7 Water bucking vent-gases built up back-pressure in tank

Now we have no more shortage of water. In fact, we have too much water. Instead of three water softeners of 40,000 gal capacity a day, only two are needed. And still there is too much water. So all the cooling water from compressors is dumped into the sewer.

We figured up the total saving since this change. It amounts to over 40,000 gallons of soft hot water at 130 F per day. That loss had been going on for several years. With higher costs today, it might pay to check all old piping.

A L LINDSAY, JR. *Cleveland, Ohio*

8—SKYHOOK . . . Do you have a rig for making that unexpected repair?

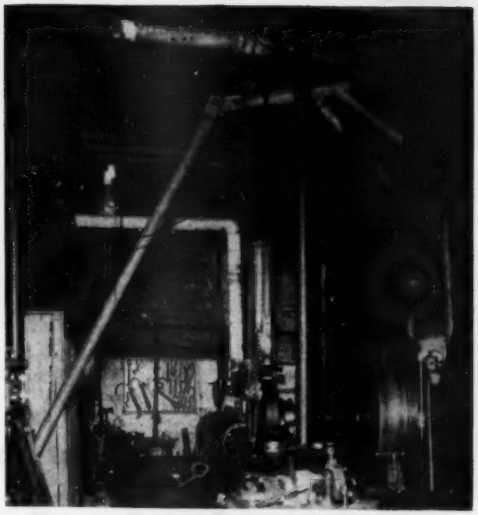
► "NEVER GET CAUGHT SHORT," has been my motto for years. That's why I made this "skyhook" when I took over an old laundry plant as chief engineer. This rig reaches up to the roof. It's old 20-ft by 4-in. hrt-boiler tubes. And it's welded and held together with bolts so I can assemble over piping right up to the roof.

It sure paid off a few weeks ago. Because the old side-kicker steam engine is so ancient, I had to tear her down completely before she shut down our plant.

I assembled the "skyhook" over the crankshaft. Then I stripped the engine of its connecting rod, eccentric, bearing caps, oil pans, guard rails, etc.

With two chain falls hung from the skyhook, I lifted the flywheel, crank shaft and crank disk high enough for me to work on the main bearing. I lined up the engine with piano wire and found it was badly misaligned. Then I keyed up the bearings and reassembled the engine. Now she runs like new. This one job alone has been worth the trouble it took to make the rig. I've seen too many roofs weakened from hooking chain falls to them.

A L SHEA *Springfield Gardens, N. Y.*



8 Lifting rig made of old boiler tubes helps with repairs

9—STRAIGHTENING SHAFTS . . . Torch, lathe and bar do speedy job

► INSTEAD of making new shafts and cutting the bent ones up for other uses, we straighten them.

Shaft is chucked in lathe, with one end through steady-rest. Lathe revolves slowly while flame is played on bent part. It doesn't take long for shaft to get red throughout bend.

Then lathe is stopped and a pinch bar placed against bend, with end resting on a block of wood on lathe bed. A hefty prying action straightens it. Lathe is started to see if more heating and more straightening is needed.

Only precaution is to make sure steady-rest is strong enough for size shaft being straightened. Also, don't heave up with a sudden jar unless your lathe is for heavy duty work. Shafts up to 3-in. diameter are worth trying to straighten in this way.

MORRIS JONES *Reading, Pa.*

9 Heating turning shaft at bend makes straightening easy

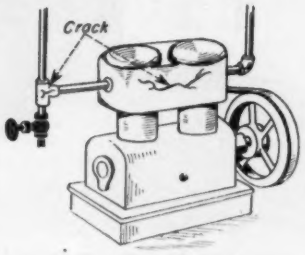
10—CRACKED JACKET . . . Prevent repair by installing drain valve now

► A TWIN-CYLINDER, 6-in. compressor for cooling calcium brine in an industrial plant operated only during the day. Water for cylinder jackets was supplied from a well on the premises.

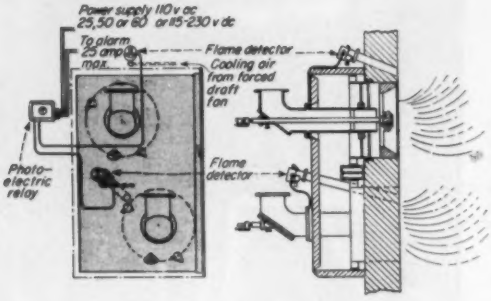
The compressor was shut down at Saturday noon, and not started again until a week or more later. When the water-supply valve to the jackets was opened, the operator was surprised. Not only had the water pipe burst, but the jacket enclosing the two cylinders was badly cracked.

There was no provision for draining the water lines and jackets during freezing weather. Theory was that "it can't happen here,"—yet it did. How about doing a little preventive maintenance on your cooling system now?

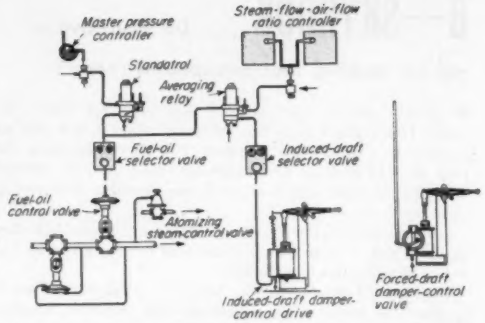
C T BAKER *Atlanta, Ga.*



10 Drain valve on machine's jacket could have saved money


Power supply 110 v ac 25,50 or 60 or 115-230 v dc
To alarm 25 amp max.
Flame detector
Cooling air from forced draft fan
Flame detector
Photo-electric relay

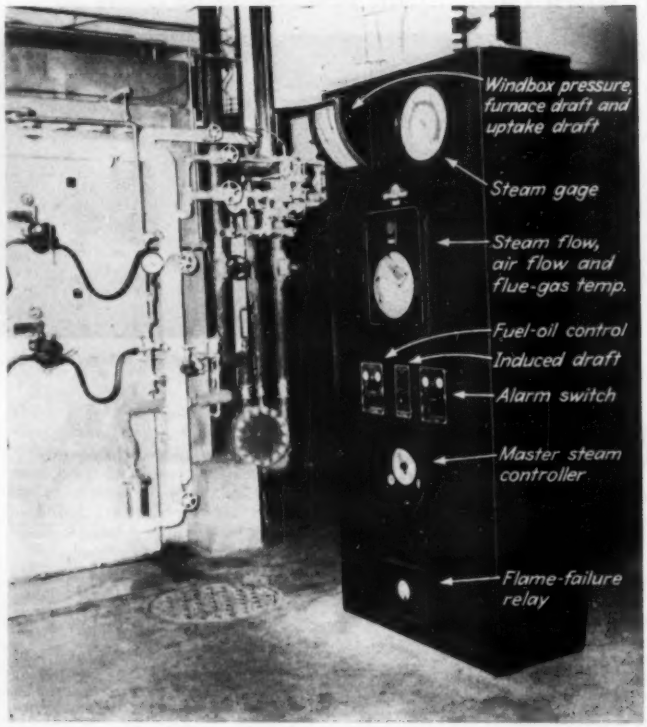
1 When flame detector activates relay, it sounds alarm and trips solenoid valve, which shuts off fuel to burners



2 Combustion is controlled to keep steam flow steady by this apparatus. This holds fuel consumption to a minimum

Now this one-boiler plant has . . .

. . . Safety And Automatic



4 Boiler control panel has everything wrapped in one small package. Operator can tell what's going on inside boiler by taking quick glance at instruments

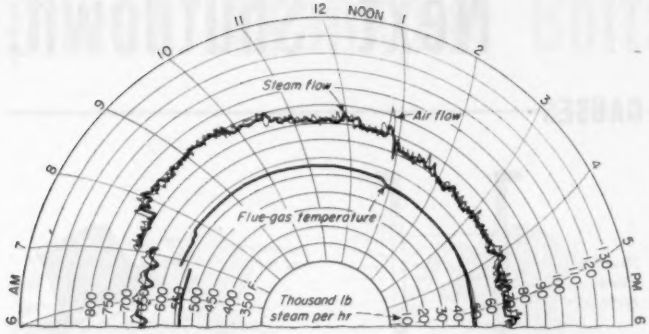
By F A WESTBROOK
Consulting Engineer

► Minnesota Mining and Manufacturing Company, makers of Scotch tape, abrasives, synthetic color pigments and numerous other products, have several plants. They recently installed at their Wausau, Wisconsin, works a very complete automatic-combustion-control system. It's interesting because of its unusual safety features for such a small steam plant.

The system is proving efficient and looks like savings will soon pay for it. Meanwhile, there's plenty of steam and uniform pressure at all times, both for heating and process work.

The boiler is a water tube and oil fired. Its maximum capacity is 14,000 lb of saturated steam per hr, at 125 psi. Normal loads vary from about 2000 lb per hr in summer to about 9000 lb in winter. This is due to added heating needs in cold weather.

Flame Detectors. A feature of this job is the protection against flame failure. Flame detector is mounted in the furnace wall, Fig. 1. This boiler is operated by a fireman for only eight hours a day, then the watchman keeps an eye



3 Typical boiler meter chart made in winter during maximum steam consumption. Steam and air pens stay together. Inside line shows the stack temperatures

Combustion Control

- ***Flame detectors guard oil fires***
- ***Automatic combustion control keeps steam steady***
- ***$$$ saved by efficient firing***
- ***Fireman and night watchman operate boiler***

on it for sixteen hours. That's why this extra safety precaution is needed.

Flame detector consists of a light-sensitive photo-tube, mounted in a special air-cooled housing. It's aimed at the point of ignition. Flame failure causes the detector to activate a relay. That in turn sounds an alarm and trips a solenoid valve, which shuts off the fuel oil to burners. This solenoid valve is also closed by other unsafe conditions, such as high or low drum-water levels and failure of a burner.

Combustion Controls. Steam-pressure changes in main header operate a pressure helix in master pressure controller, Fig. 2. By means of an air pilot, the helix transmits control loading pressure to the fuel-oil valve and to induced-draft damper-control drive. This restores steam pressure in header to standard operating pressure of 125 psi.

Function of oil-pressure-differential control valve is to keep a fairly constant fuel-oil pressure differential between fuel-oil valve's inlet and outlet. This assures a steady oil flow to burners.

Fig. 2 also shows steam-flow-air-flow ratio controller of boiler meter. This holds correct ratio of fuel-oil flow to air flow by making automatic adjustments at induced-draft damper control drive. Selector valves shown permit manual operation of both.

A forced-draft damper-control drive, Fig. 2, has a furnace-draft connection. Changes from desired furnace draft cause drive to open or close the forced-draft damper. Remember, this is a combination furnace-draft controller and control drive, which has no other connection with other automatic combustion-control equipment.

Fig. 4 shows boiler-control panel. At top left is multi-pointer gage which indicates windbox pressure, furnace draft and uptake draft. At right is pressure gage with range from 0 to 300 psi.

Below these, in center, is large boiler meter. This records steam flow, air flow and flue-gas temperature. It also integrates steam flow and controls steam-flow-air-flow ratio in automatic combustion-control system.

Three instruments together are, from left to right, (1) selector valve for manual or automatic operation of fuel-oil control valve; (2) selector valve for manual or automatic operation of induced-draft damper drive and, (3) alarm switch. Alarm switch has two lights. One indicates flame failure and other low water level in boiler drum. When alarm is sounded, attendant knows source of trouble at a glance.

Below these three is master steam-pressure indicator-controller. At panel's bottom is photo-electric flame-failure relay. Panel takes up little space.

Boiler-Meter Chart. Fig. 3 is a reproduction of a typical boiler-meter chart. It was made in winter during maximum steam consumption. Two outer recordings are of steam flow and air flow. They follow each other very closely. The inner recording shows flue-gas temperature, which is held uniformly.

This meter is three instruments in one—a combustion guide, a flue-gas temperature recorder, and a steam-flow meter. The operator knows at a glance whether best combustion efficiency and best furnace conditions exist.

When meter was installed, factory representative ran a complete test. He took many orsat analyses of flue gases at different ratings and with several precentages of total air.

He listed conditions of fire, refractories, burning equipment and other factors. On basis of test results, air-flow mechanism of meter was adjusted so when air-flow pen records same as steam-flow pen, the percentage of total air is as low as possible. That means low air without appearance of limiting factors, such as unburned gas (CO) in stack, excessive refractory deteriorations, smoke, or carbon in ash. This optimum percentage of total air may be either constant or graduated with boiler rating.

Steam flow and air flow must always be kept together to show same chart readings, regardless of boiler load. Pens staying together indicates right amount of air for most economical combustion. Excessive air, resulting in needless heat loss to stack, is shown by air-flow pen *above* steam-flow pen. Not enough air means serious losses from incomplete combustion and is shown by air-flow pen *below* steam-flow pen.

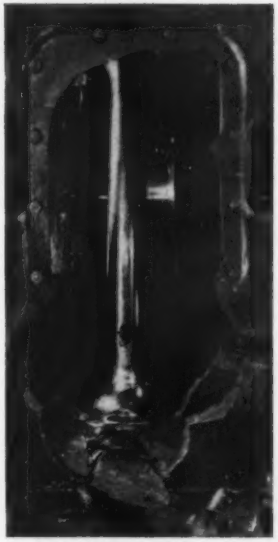
Burning fuel so steam-flow-air-flow pens stay together means: (1) most economical combustion; (2) boiler absorbs more heat from higher temperatures and from longer exposure to heating surfaces: (3) refractory lasts longer and (4) higher maximum boiler capacity. Only automatic firing does these.

The author wishes to acknowledge the help of Bailey Meter Co, builders of control equipment for data used in the preparation of this article.

OPERATORS' NOTEBOOK 40

Next Shutdown,

DAMAGES

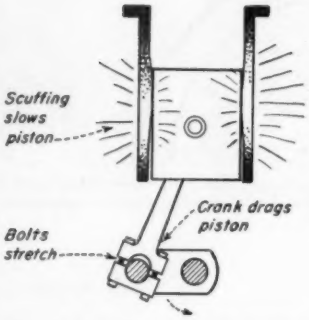


CRANKCASE wreck ($4771 here) is most common damage when bolts fail

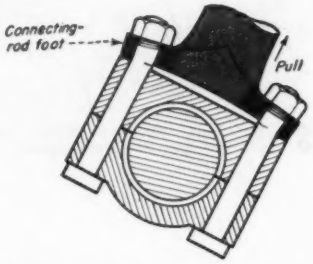
PISTON SKIRT AND ROD break from smack by crank when bolts let go

CRANKSHAFT jamming loose parts when bolts fail can cause this

CAUSES

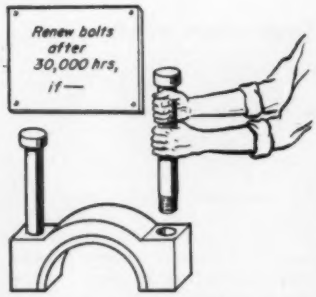


PISTON SEIZING or scuffing stretches crankpin bolts in a multi-cylinder engine as crank drags piston along

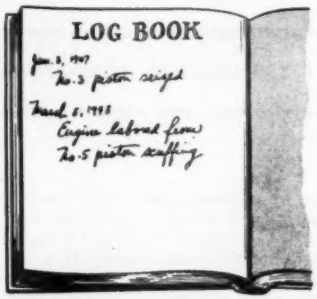


CONNECTING-ROD foot flexing bends bolts. This also happens from piston scuffing. Check foot with straightedge

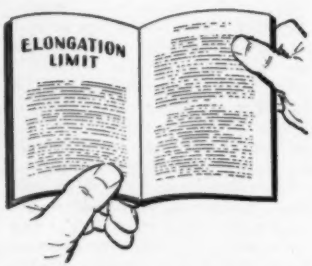
PREVENTION



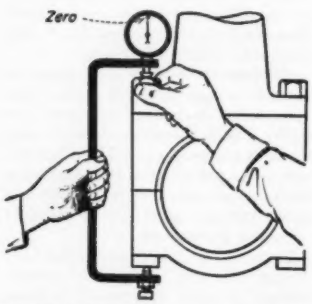
RENEW BOLTS after 30,000 hours of engine operation if engine has run smoothly with no scuffing or seizing



CHECK LOG for engine's history since last bolt change to see if conditions existed that could cause bolt elongation



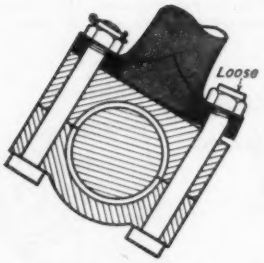
DON'T EXCEED bolt's elongation limit from engine instruction book. Reaching limit means bolt reached yield point



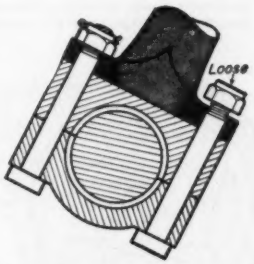
BEFORE TIGHTENING new bolts with wrench, use your stretch gage like this and set the dial so it registers zero

Check Crankpin Bolts

By STEVE ELONKA *Associate Editor*

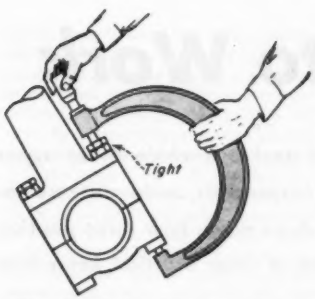


NUT COMING LOOSE strains other bolt. Tap all nuts every few months with light hammer. Sound shows loose nut

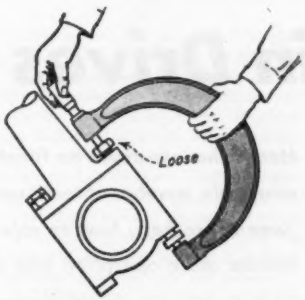


NUT NOT TIGHTENED is next. Or one nut pulled up tighter. Both bolts must have exact strain to avoid trouble

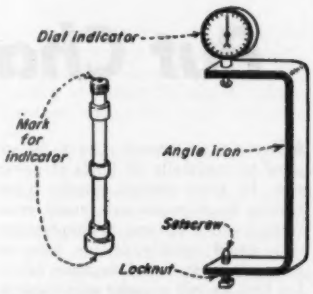
STRAINING bolt from over-tightening is common. Torque wrench is NOT answer as thread friction varies on both nuts



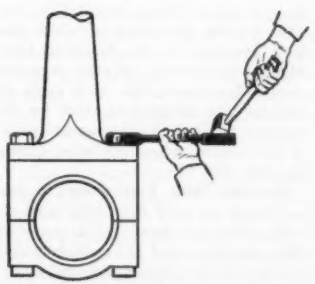
BEST CHECK for bolt elongation or stretch is to mike the bolt **before** loosening nuts, with bolts strained



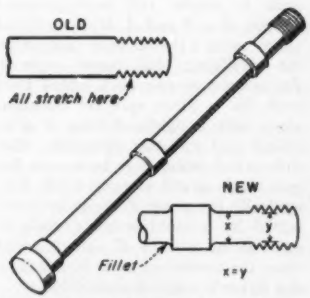
THEN MIKE the bolt **after** loosening nuts. Compare measurement with that of tight bolt for amount of stretch



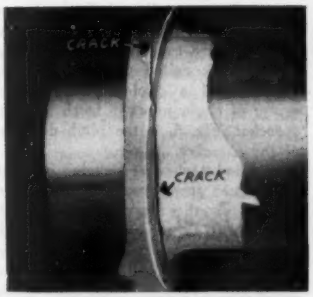
IF NO LARGE MIKE, make 'stretch gage' from strap iron and dial indicator. Always read at same spots on crank bolt



TIGHTEN BOTH BOLTS until stretch indicated on dial is exactly same for both. Record bolt's stretch in the log

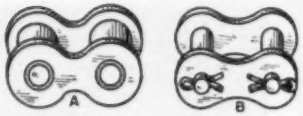


CHROME MOLYBDENUM steel SAE-41-30, ASA 3125 and 3130, with collars, stretch full bolt length, relieve threads

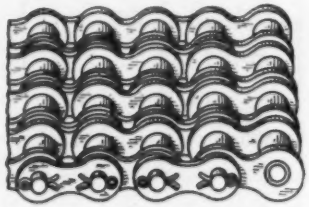


WHITEWASH TEST shows hidden crack. Clean the bolt, rub with kerosene, wipe dry, then whitewash. Crack will show

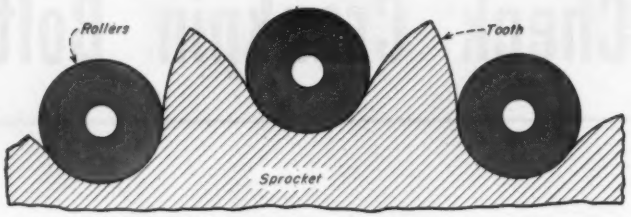
1 Single-strand finished-steel-roller chain runs on cut-tooth sprockets



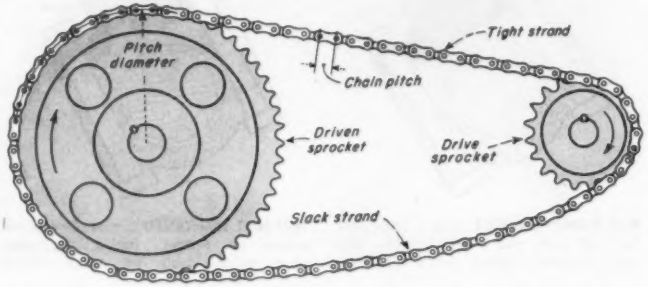
2 Steel-roller links. A: roller or inside link. B: pin or outside link of a chain



3 Multiple-strand finished-steel roller chain is used for increased power



4 Steel-roller-chain sprocket profile approved by the American Gear Manufacturers' Association, takes care of increased chain pitch due to wear of chain links



5 On roller chain, distance between chain joints is its pitch, and diameter of circle through the chain joints in mesh with sprocket is pitch diameter of sprocket

Put Chain Drives to Work

Here's the low-down on finished steel roller-chain drives—types available, number of teeth used in sprockets, center-distance between sprockets, how to select chain drive, how drive position affects chain operation and a lot of other practical know-how

►POWER-TRANSMISSION CHAIN is applied to practically all kinds of power jobs. Its great strength permits transmitting large power with small cross section, and it can run in temperatures that would quickly destroy belts or ropes. It is developed in many forms, but here we will consider only finished-steel-roller designs.

Roller Chain. Such a chain drive is simple in construction, consisting of two or more toothed wheels, "sprockets," mounted on parallel shafts and connected by an endless chain. Center distance between two adjacent joints, Fig. 1 and 5, is called the chain's pitch. Diameter of a circle drawn through center of chain joints in mesh with the sprocket, Fig. 5, is the pitch diameter of the sprocket.

Finished-steel-roller chain on cut-tooth steel sprockets is a highly developed type that can run at high speeds and be built to transmit large power. It consists of roller links connected by pins and side links, Fig. 1. A roller or inside link, Fig. 2, is an assembly of two rollers and two bushings, whose ends are pressed into holes in the two side links. A pin or outside link has two pins, whose ends fit tightly into two pin link plates.

Number of Strands. Roller chains are built in single- and multiple-strand designs, Fig. 1 and 3. Multiple-strand allows using a shorter pitch chain without sacrificing high power capacity. Because the shorter pitch allows more teeth for a given sprocket diameter, along with a lighter driving, it gives quieter and smoother operation. Multiple-strand chains may be run as fast as a single strand of equal pitch. Theoretically the power that can be transmitted by a multiple-strand chain is equal to the capacity of a single-strand times the number of strands. Actually, this figure is reduced about 10%.

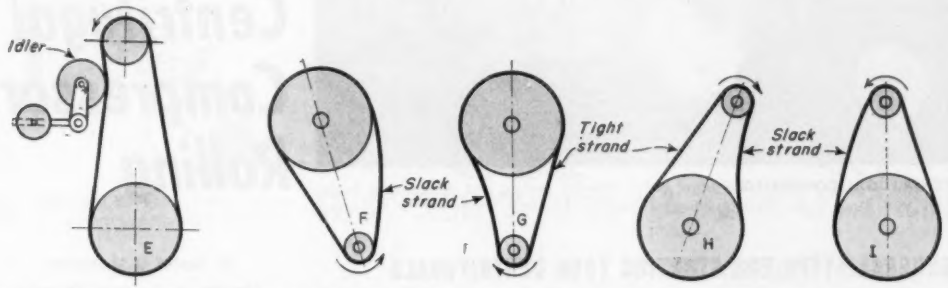
Extreme care used in manufacturing some roller chains makes them suitable for speeds up to 4000 ft per min. But unless the chain is enclosed and lubricated, don't exceed 1400 ft per min.

Sprocket Standards. To get full advantage of modern roller chain run it on sprockets having accurately machined teeth, the shape of which has been approved by the American Gear Manufacturers Asen. and other organizations. This shape, Fig. 4, is made of circular arcs designed to allow for the increase in pitch due to natural wear. It provides maximum efficiency during sprocket life.

Sprocket Teeth. Even though as few as five or six teeth have been used on roller-chain sprockets, and as many as 250, experience and research show that (on the basis of speed and efficiency), the number of teeth should be kept well

*This article is based on information supplied by the Power Transmission Council

6 Arrangements of horizontal chain drives. On normal- or short-center drives the slack strand may be run on top or bottom. The slack strand operates best on the bottom because the loose strand tends to disengage from the sprocket teeth



7 Arrangements of vertical chain drives. Avoid vertical drives where possible, but where they must be used keep them fairly tight by frequent adjustment. Have chain slightly off vertical if possible to help reduce maintenance and adjustments

within these limits. Chain manufacturers generally agree that a 17-tooth sprocket is about the minimum for high speeds, and 19 or 21 teeth are even better. Upper limit should be about 125 teeth. It is good practice to use an odd number of teeth on the smaller sprocket.

If the number of teeth is below the recommended minimum, the increased shock or hammer action on the rollers as they meet the teeth increases wear and shortens chain life. If more than 125 teeth are used, a small pitch increase causes the chain to ride the sprocket long before chain is worn out.

Sprocket Center Distance. On any chain drive, the minimum center distance between shafts must be greater than one half the sum of the diameters of the two sprockets. Experience shows that best results are usually had when distance between shaft centers is 30 to 50 times chain pitch. Forty times chain pitch is near normal, while 80 times is about the limit. On highly pulsating loads, 20 to 30 times the pitch is nearer the correct center distance.

Center distances of 10 to 12 ft can be used with finished-steel roller chain without an idler to keep the chain from flopping. For distances greater than this, an idler should be used to prevent swaying or flopping of the chain that may cause it to jump a sprocket. When an idler is used, place it on the slack strand of the chain. Have the number of teeth in the idler not less than that in the smaller sprocket of the drive.

Choose the Right Chain. The proper chain drive for the average job can usually be found from tables in chain manufacturer's catalogs. Because of different methods of manufacture and materials used, horsepower limits of chains found in catalogs may vary. So follow the manufacturer's chain recommendations.

For special jobs ask for help from the chain manufacturer. To help him do an intelligent job give him this dope:

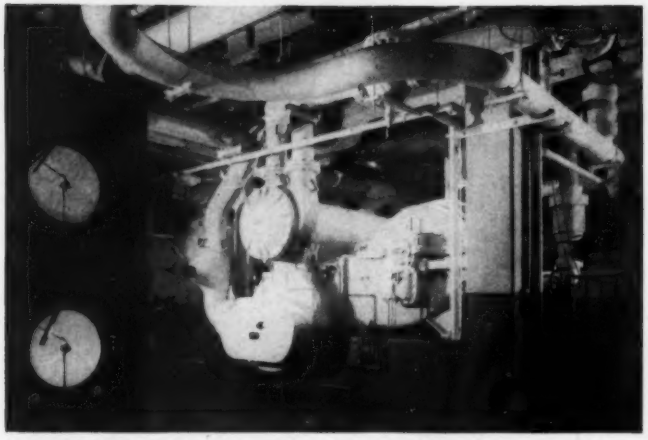
1. Horsepower and type of motor, how started and how often.
2. Speed (rpm) of driving and driven sprockets along with shaft diameter for each and how sprockets are fixed to shafts.
3. Maximum permissible diameter of sprockets.
4. Available space for drive.
5. Position of drive relative to floor level.
6. Operating conditions, such as number of hours' operation per day, lubrication, moisture, dust and dirt.
7. Maximum and average load, whether steady or pulsating, and starting conditions.
8. If prime mover is other than electric motor, give type.

Drive Positions. Figs. 6 and 7 show typical chain-drive positions. On short- or normal-center drives, the slack strand may be either on top or bottom. Slack strand runs better on the bottom, because a loose top strand tends to disengage the drive-sprocket teeth. On long centers, to prevent the strands rubbing together, make slack strand the bottom one.

Where possible, avoid vertical drives, Fig. 7*G* and *I*. If you must use them, keep them fairly tight by frequent adjustment. But you can reduce care and adjustments if the drive can be installed slightly off vertical, Fig. 7*F* and *H*.

Drive Alignment. Accurate alignment of any chain drive is an absolute must for troublefree operation. Make the shafts, to which the drive connects, level and parallel and the sprockets in line. You can check sprocket alignment with a string or straightedge held against their sides. As with belt pulleys, locate chain sprockets as nearly as possible to shaft bearings. To avoid excessive vibration have motors or shafting mounted rigidly.

Don't run roller chains with both strands tight. For best results have center distance between sprockets adjustable, to take up slack caused by wear. There is no definite rule for correct tension in a chain drive. In horizontal and inclined drives, normal practice allows a sag (when running) equal to about 2% of the center distance between sprockets. This is more than that used on belt drives, but it works well. On loads that fluctuate badly, run chain practically tight, to reduce flopping.



CENTRIFUGAL COMPRESSORS serve many different cooling and refrigeration loads. This unit in a large office building is kept in topnotch shape by its operators

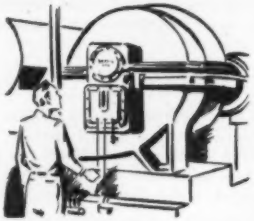
Here's inside dope on centrifugal-compressor operation. Try it on your refrigeration job. It's easy to learn . . .

How to Keep Centrifugal Compressors Rolling

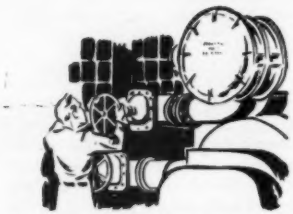
By JAMES G MANNING

Manager of Equipment Operation
Carrier Corporation

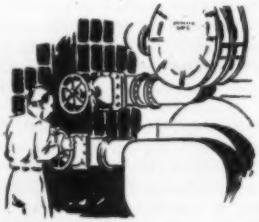
GENERAL STEPS FOR STARTING YOUR CENTRIFUGALS



1 **CHECK OIL LEVELS** in compressor, drive, gear, coupling. They must be OK



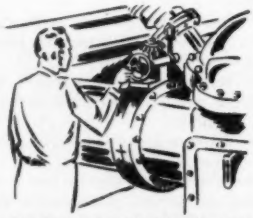
2 **START CONDENSER-WATER** flow. Be careful to avoid water hammer here



3 **START BRINE** circulation through brine cooler. Avoid water hammer

4 **CHECK AIR PRESSURE** for air-operated controls. It must be OK for start

5 **RUN PURGE UNIT** to rid machine of air. Always do this before starting



6 **CLOSE SUCTION DAMPER** only as far as needed on synch-motor drives

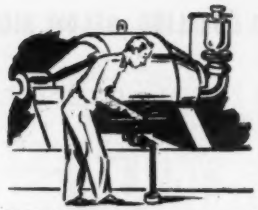
► SLIPSHOD OPERATING METHODS mean trouble for any machine, centrifugal compressors included. It isn't hard to operate these units right—all you need is common sense, a knowledge of how centrifugals work, and good instruction on the characteristics of your machine. So let's see how experienced operators get the most from their machines.

Compressor Design. Most centrifugals are custom built for a certain job. So if you operate them right you'll always get output the machine was designed for. But since custom building makes each machine a trifle different from others, we can give only general rules for good operation. Where machines differ from units shown here, consult manufacturer when tough problems arise. He knows what's best for each design.

Starting. Glance over the 12 sketches, *left, and facing page.* These give a good, general starting procedure. Remember that on certain jobs you may have to use a different one.

As we said, this is a general starting procedure, so some of our sketches need more explanation.

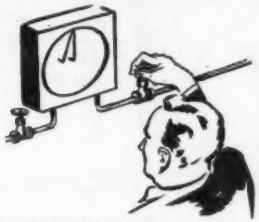
Run purge-recovery unit, 5, either continually while machine operates or when purge shows it's needed. After starting synchronous-motor-driven units, 6, open suction damper as required as soon as compressor hits full speed. Turbine starting, 7, depends on turbine



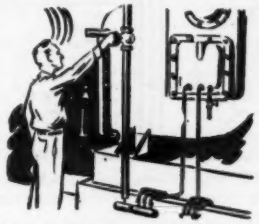
7 **WARM TURBINE** on turbine-driven machines. Use drains before starting

8 **CLOSE HOLDING CIRCUIT** for safety controls, if necessary for starting

9 **BRING MACHINE** to speed. Check seal-oil gages for right oil pressure



10 **OPEN AIR SUPPLY** to controller on automatically controlled machines



11 **OPEN SUPPLY VALVE** in water line to oil cooler on unit, drive, gear

12 **RUN AT HIGH SPEED** if machine surges. This accelerates purging

make. Adjust governor control valve to minimum setting and make sure all drains blow steam before starting. Bring turbine to speed. If seal-oil pressure, *9*, doesn't develop within a few seconds after starting, stop machine and restart.

On automatically controlled machines, *10*, opening air supply to controller brings machine under supervision of controls. Sketches, *this and next page*, show typical automatic controls. Keep water flow to compressor oil cooler at low rate until highest bearing temperature is about 130 F. Adjust to give 140 to 180 F bearing temperature or value builder recommends. Check temperatures of all bearings on compressor, gear and drive until they level off at right point.

Surging. Surging operation is normal for centrifugal compressors — there's nothing to worry about. But at low loads, 10 to 20% of full load, surging causes compressor overheating, and bearings get hotter. So don't operate continuously under these conditions. If you want to operate continuously at light loads, a hot-gas bypass may be needed.

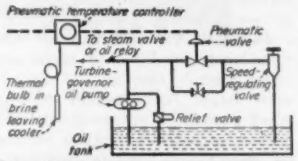
Right after starting there may be a period of surging until all air is removed from the condenser. Meanwhile run machine at high speed. But condenser pressure shouldn't exceed 15 psig for Freon-11 during high-speed period. Also, input current to motor of motor-driven units shouldn't be more than 100% of full-load motor rating. Don't overcool evaporator because nonfreeze control will stop machine. Adjust speed or damper to give right brine temperature after machine has steadied and all air is purged.

Operating Controls. You can use three methods for hand controlling capacity of centrifugal compressors on refrigeration jobs: (1) vary compressor speed (2) throttle compressor suction, or (3) increase compressor discharge pressure. No. 1 is most efficient; No. 3 least.

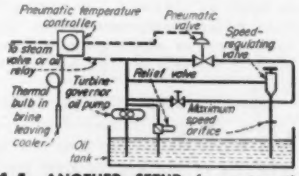
You change speed at driver, be it motor or turbine, except with constant-speed motors using magnetic slip or hydraulic coupling. Throttling damper in cooler suction connection is used for suction-damper control. Throttling suction increases the pressure range through which compressor must handle refrigerant vapor. Since machine has a flat characteristic curve, pressure range against which it will deliver is limited by operating speed. So suction throttling is a good method of control. It uses a little more power at partial loads, but it gives stable (nonsurging) operation at lower loads than variable-speed control. Some machines are fitted with both variable-speed and damper control.

Condenser-water control isn't often used, but has its good points for machines taking condensing water from city mains or other high-cost sources. When you throttle condenser-water flow you get same action as with a suction damper. On some jobs lowest speed you can get with variable-speed control may not be low enough to meet your

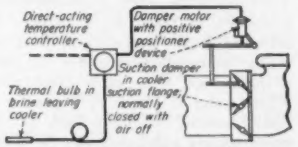
SOME AUTOMATIC CONTROLS



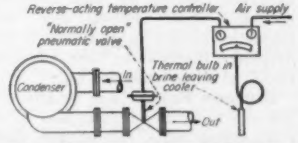
13 **AUTOMATIC VARIABLE-SPEED** control—turbine-driven compressor



14 **ANOTHER SETUP** for automatic variable-speed control; turbine drive

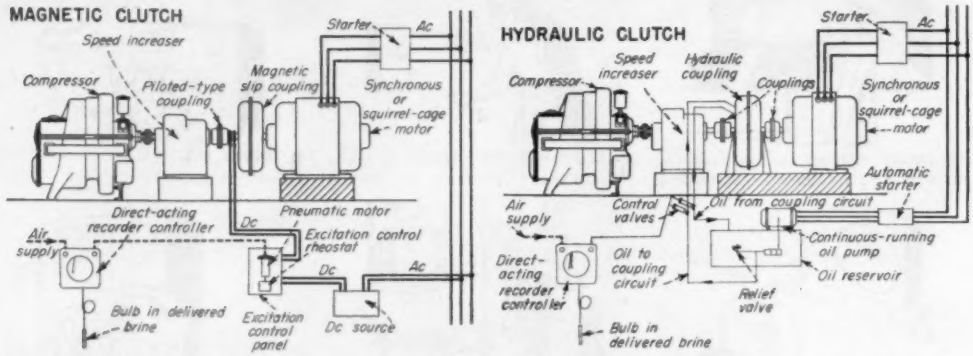

Direct-acting temperature controller
Damper motor with positive positioner device
Suction damper in cooler suction flange, normally closed with air off
Thermal bulb in brine leaving cooler

15 **AUTOMATIC DAMPER CONTROL** regulates throttling in suction



16 **AUTOMATIC CONDENSER-WATER** control uses a diaphragm valve

UNIT, BELOW LEFT, USES MAGNETIC SLIP COUPLING; HYDRAULIC COUPLING, BELOW RIGHT



17 **AUTOMATIC VARIABLE-SPEED CONTROL** of motor-driven centrifugal compressors uses magnetic slip coupling, *left*, or hydraulic coupling, *right*. Temperature-sensitive bulb in brine-cooler discharge actuates the control for change of speed

operating needs. On these jobs you may throttle condenser water and bring compressor speed into range of control.

Automatic Controls. You can have these hand-control methods under automatic control. Sketches, *13* and *14*, show setups for automatic variable-speed control of turbine-driven units. System automatically adjusts compressor speed to hold constant the delivered brine temperature. Rise or fall of brine temperature works through controller to supply air or bleed it from pneumatic valve in turbine-governor system. This valve opens or closes governor steam valve to increase or decrease turbine speed.

Sketch, *15*, shows automatic damper control. Temperature-controller regulates degree of damper throttling by supplying or bleeding air from pneumatic damper motor. Condenser-water control, *16*, uses diaphragm valve in water discharge. Valve is automatically positioned in response to changes in delivered brine temperature. Reverse-acting temperature-controller supplies or bleeds air from valve diaphragm. Where water is scarce or expensive a similar control having a bulb in the water leaving condenser can be used.

Sketches, *17*, show control methods for motor-driven units with magnetic or hydraulic clutches. In small machines excitation-control rheostat used with magnetic clutch is in dc supply to slip couplings. Bigger units have it in field circuit of motor-generator set.

Shutdown Periods. You usually run into two types of shutdown periods on refrigeration jobs: (1) standby shutdown when machine must be ready for instant use (2) extended shutdown when machine is definitely out of service. Here's how to handle each:

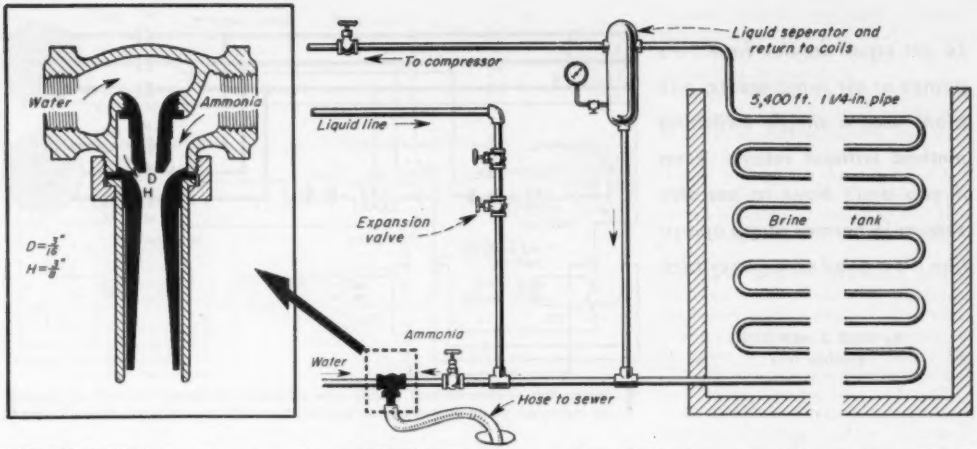
During standby shutdown: (a) Run purge-recovery compressor as needed to keep pressure in machine slightly below atmospheric. (b) Keep machine free of air leaks. (c) If machine pressure builds up from warm machine room instead of air leakage into unit, circulate small quantity of water at less than 70 F through cooler or condenser. Do this either intermittently or continuously. Or operate purge-recovery unit to pull pressure down. (d) Run machine a few minutes once a week to circulate oil and reduce refrigerant temperature. Be sure refrigerant temperature in cooler is not lowered below freezing point of water or brine in tubes. (e) Keep machine room above freezing temperature. (f) Keep right oil level.

For long shutdowns where system is known to be free of leaks and purge-recovery unit holds machine pressure down to proper value, follow instructions for standby shutdown. In addition, (a) if freezing temperatures are likely at machine location, drain all water from compressor, gear and turbine-oil coolers. Also drain water from condenser, cooler, seal jacket, pumps, piping and other units. (b) During long shutdown, oil may be excessively diluted by refrigerant. If oil level in pump chamber rises into rear bearing chamber, remove entire oil charge and tag motor switch or turbine.

Lubrication. High-grade turbine oil is recommended for compressor lubrication. Whenever you're in doubt about right grade of oil, consult builder. It's usually most convenient to add oil only when machine is running, being careful not to overcharge the oil system. Oil level falls as the oil is circulated during starting, but under normal running conditions the oil charge increases 5 to 7% in volume as it absorbs refrigerant. Usual level during operation is about half glass. Electric heater in oil-pump chamber warms oil charge during shutdown and prevents excessive absorption of refrigerant. When machine is shut down, turn heater on; off, when cooling water is turned on before machine is started.

Under usual operating conditions you'll find these suggestions helpful: (1) Replace complete oil charge once a year. (2) At any time when all or a portion of the oil charge is removed, replace with fresh oil from a sealed container. (3) After shutdowns of more than one month remove bearing covers and add one quart of oil to each bearing well before starting. (4) Replace oil filter periodically, depending on operation and condition of the filter. (5) At least once a year inspect and clean oil strainer.

To drain oil system, allow machine temperature to rise or artificially heat machine until cooler temperature is 75 F. This corresponds to atmospheric pressure for F-11. Drain pump and atmospheric float chambers. This removes practically all oil. Portion of charge remaining in bearing wells and seal reservoir is useful for keeping bearings in good condition and as a seal. Remember, many of these hints are general and may not apply to your machine. Consult builder if you are in doubt.



EJECTOR DETAILS show how it's made from a ¾-in. valve to pump ammonia

AMMONIA in this system was dumped with ejector through hose to sewer. Then it was pumped down to vacuum and held while repairs were made to piping by welding

Ejector Dumps Ammonia

1—Dumps ammonia from damaged system

2—Removes ammonia fumes quickly

3—Holds vacuum while repair is made

By S C PAGE, *Buffalo, N. Y.*

►OCCASIONALLY conditions arise where you have to empty some part of a refrigeration system and waste the ammonia to get at a repair job quickly. Because ammonia is highly soluble in water, a water ejector is ideal.

Problem. On one job, a 3-in. gas line from brine tank corroded through. The old plant had three 10 x 10 crankcase-type compressors. Around-the-clock service took two compressors running steadily. And all three were overloaded in hot weather.

The break was between the header valve and the brine tank. When pumped down to a vacuum, so much air leaked in, the purger couldn't handle it. Then condenser pressure soon went to top limit. Something had to be done without delay.

I made an ejector from a ¾-in. valve. With 60 psig water at inlet and the suction closed to injector, a temporary gauge showed 23-in. vacuum. With the ¾-in. valve one quarter open, vacuum was 12 in. This would do the trick. Ejector was hooked to drain connection as shown to lowest point in ammonia coils of the brine tank on this job.

A 1¼-in. hose on outlet carried ammonia water to sewer. Three hours and I had ammonia and oil out of coil. Coil had 5400 lineal ft of 1¼-in. pipe. Then repairs could be made in comfort, with no gas coming out the open suction pipe from coils.

This ejector handled enough air to produce a flow of air in open end to carry away all fumes coming from oil-soaked coil. We turned off ejector after all pipes were tacked in place and welding started. The fumes soon drove the welder away, so we ran ejector another 10 minutes.

At the last weld, the vacuum pulled the molten metal in the pipe so it could not be welded tightly. We turned off ejector so the pressure balanced for final weld. When welding was done, the ejector drew only 14-in. vacuum, indicating a leak. We tested system with compressed air. This revealed a pin hole in the last weld. When this was gouged out, rewelded and ejector started, vacuum shot up to 23 inches.

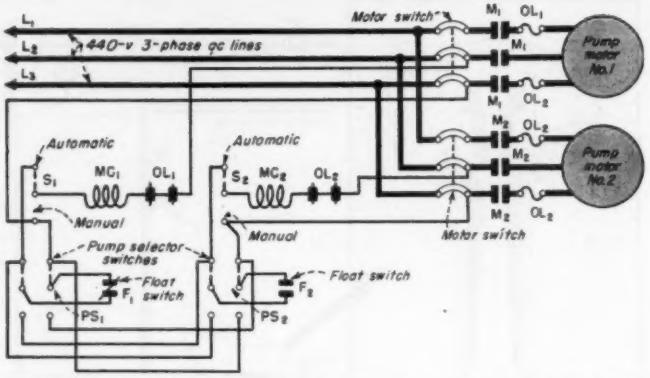
We slowly applied dry gas from suction header with ejector on, to force out all remaining air. When water from ejector discharge changed from clear to opaque, with strong ammonia fumes present, most of the moist air was out of the coil.

During the next few years this system was rebuilt and capacity doubled. We made a practice of using the ejector to pump out everything that had been open to the atmosphere. That removed the moist air. When new parts of the system went into service, condenser pressure never increased because of air accumulation. That proved most air had been removed by the ejector.

Ammonia gas, filling the system, does not mix much in a coil when admitted slowly at the top. With the ejector pulling air out at the lower end, the change in discharge is very abrupt. With ejector-discharge hose in a bucket, as long as air comes out, it bubbles up through the water. When ammonia comes, water turns opaque quickly. Even with suction valve on ejector nearly closed, the change from all air to all ammonia took only about a minute.

To get equal service from two pumps or air compressors, one plant uses a simple switching method without relays. Even if you don't have to use this system in normal pump operation it's a good emergency trick

By **FRED J ARDOLINO**
Brooklyn, N. Y.



1 When the single-pole and double-pole switches are closed to their up position as indicated, pump motors are on automatic control from float switches F_1 and F_2

Switches Replace Relays

► ON MANY WATER systems two or more pumps are used. They should be operated so that each does about an equal share of the work. Unless this is done one pump wears faster than the other.

Operating Schedule. A common operating schedule calls for starting No. 1 pump first one week and No. 2 when needed to supply the demand. During the next week No. 2 starts first followed by No. 1 as needed.

When the pumps are under manual control they can be started and stopped on any schedule that suits the operator. Automatic control should include some means for changing the operating schedules, so that each pump will run about an equal time.

Automatic Control. Several automatic control systems have been developed to schedule pump operation. Some of them use complicated relay systems. We have worked out a simple system in which we use only single-pole and two-pole double-throw knife switches to control two pumps.

Even if these switches cannot be made as foolproof in their operation as relays they have the advantage of being easy to buy at any electric-supply store. This may be a real advantage if you need the switches in a hurry for an emergency or temporary job.

Control Diagram. Fig. 1 shows the control as applied on two three-phase 440-v pump motors. Contactor coils MC_1 and MC_2 connect to single-pole double-throw switches. When these switches are closed in their up position, as shown by the dotted lines, the motors are on automatic control from float switches F_1 and F_2.

No. 1 float switch is set to close at a higher water level than No. 2. Then the pump connected to No. 1 will start first.

Double-Pole Switches. Float switches connect across the center contacts of two double-pole double-throw switches, PS_1 and PS_2. When these switches are in the up position, pump No. 1 starts first. If the water level continues to drop No. 2 float switch closes and No. 2 pump starts. Let's see how this is done in actual operation.

Pump Operation. When No. 1 float switch F_1 closes it completes a circuit through motor contactor coil MC_1. This circuit is from L_2 through the motor switch, overload contacts OL_1, contactor coil MC_1, switches S_1 and PS_1 the float switch to line L_3. Contacts M_1 close and pump No. 1 starts.

Pump No. 2 cannot start because contactor coil MC_2 is open through float switch F_2. If the demand for water is more than pump No. 1 can supply, water level continues to fall until F_2 closes to connect contactor coil MC_2 across lines L_2 and L_3. Contacts M_2 close and start pump No. 2 to help fill the storage tank.

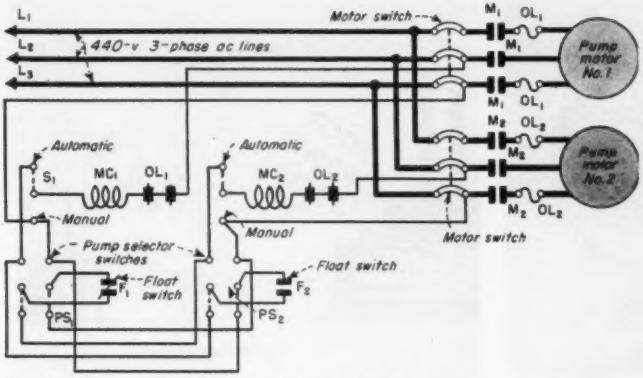
Peak Demands. When water level rises above that for which float switch F_2 is set, this switch opens and stops pump No. 2. If the peak demand has passed, No. 1 pump can fill the tank and No. 2 remains shut down.

When there is another peak that No. 1 pump cannot handle water level drops to close No. 2 float switch and No. 2 pump comes into service again. This operation continues, No. 1 pump taking care of normal water demand and No. 2 the peaks, as long as the switches are in their up positions.

Reverse Pump Operation. Closing the pump selector switches to their down positions, as in Fig. 2, causes No. 2 pump to start first. The circuit for contactor coil MC_2 is from line L_2. Then through overload contacts OL_2, the coil, switches S_2 and PS_2, float switch F_1 to line L_3. Contacts M_2 close and pump No. 2 starts. In this case No. 1 float switch F_1 starts pump No. 2.

Should the water level continue to drop float switch F_2 closes and starts No. 1 pump. Circuit for contactor coil MC_1 is from line L_2, overload OL_1, the coil, switches S_1 and PS_2 float switch F_2 to L_3. Contacts M_1 close and pump No. 1 starts. Here No. 2 float switch controls No. 1 pump. When water level rises to where float switch No. 2 opens No. 1 pump stops until it is needed again to hold water level.

One Pump Needed. On many systems only one pump is required to supply the needed water. Under this condition the pump that starts first does all the pumping and the other remains as standby. If something happens to stop the active pump, water level drops to



2 Closing the single-pole and double-pole switches to their down position causes float switch F_1 to start pump motor No. 2, and F_2 to start No. 1 pump motor

in Pump Control

where the lower float switch closes to start the idle pump.

Closing of Switches. Proper closing of the selector switches depends on the human element. This raises the question—what can happen if the switches are not properly handled? The answer is, nothing much. Either the pumps don't start or only one pump operates. Outside of leaving the switches open about the worst that can be done is to close one switch up and the other down.

Assume that switch PS_1 is closed up and PS_2 down. No. 1 pump would operate normally from float switch F_1, as previously explained. Switch PS_2 being closed down would break the circuit through coil MC_2. It is now connected to the two bottom contacts of PS_1, which are open.

Closing switch PS_2 down does connect float switch F_2 to the contacts of switch PS_1. This is the same as connecting the two float switches in parallel, but will do no harm.

It might on the other hand be helpful. If switch F_1 were defective and did close, when water level dropped to switch F_2, this switch would close and start pump No. 1. When water level comes up to where F_2 opens, the pump stops. In this case the tank will be kept partly filled. If the double-throw switches are thrown to their opposite position the running pump will be put on the high-level float switch. The tank will then be filled to normal level.

Two Switches as One. You can insure that both switches will always be in the same position by connecting them together so that they operate as one. This however does not let you cut out one pump for inspection and maintenance. It is therefore best to leave the switches separate, because of the added ease of operation.

Manual Control. When these switches are closed down they connect coils MC_1 and MC_2 directly across the line. This permits operating the pumps on manual control in case the float switches fail or are being repaired. Also the pumps can be stopped and started at will during normal inspection and maintenance work.

We use hookups like those in the diagrams on all of our dual-feedwater, sump, service-water pumps and air compressors. In this way we get balanced operation of each pair of units. We find that switches cost less than relays and give us less trouble.

Air Compressors. On air compressors, pressure switches replace the float switches in the diagrams. One switch is set for the required pressure and the other for about 10 psi lower. If one compressor cannot supply the air demand, pressure drops and starts the other compressor.

No. 1 compressor may be operating from the higher pressure switch and stop. No. 2 will pick up the load but will operate at a lower pressure. Throwing the double-pole switches to their opposite position will put No. 2 on the higher-pressure-switch operation.

Air Past Pump Packing

► WHEN CENTRIFUGAL pumps operate against a suction lift, pressure at the impeller's eye is less than atmosphere. Under this condition, air may leak through the shaft packing, unless a proper liquid seal is used.

An engineer asks if air can leak into a centrifugal pump through improper packing, even when the pump operates under a positive suction head. The answer to this question depends on what is meant by positive suction head.

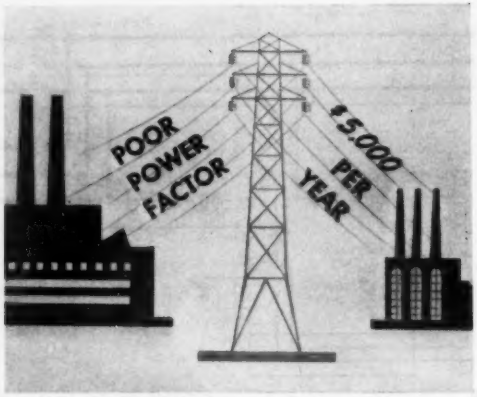
Before starting the pump we may have several feet of static suction head on the pump's suction. But, because of a long suction line improperly installed, the pressure at the pump's suction may drop below atmosphere when the pump is running. When this happens, air can leak into the pump by the packing.

Pumping from a tank is another condition. With the tank full, when the pump is first started it may have a positive suction head on the pump intake. As the tank is emptied the positive suction head is reduced. A condition may be reached where the lower static head less the head loss in the suction piping may change the pressure from positive to negative at the impeller's eye. What is still worse, air may come into the pump from the tank through the suction line.

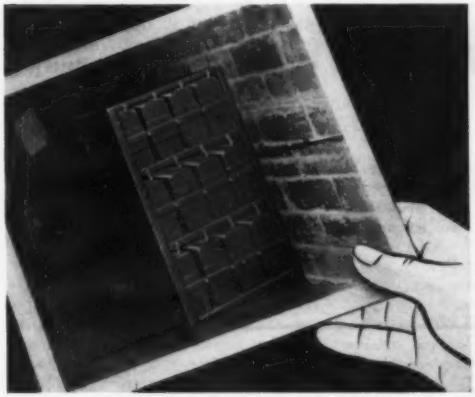
If liquid is agitated in a tank it will absorb a lot of air. When a pump's suction connects to the tank, air is taken into the pump along with the liquid. When this happens, one may believe that air is coming through the pump's packing.

So there are many ways that air can get into a pump that has a static positive suction head. But, if a positive suction head is maintained at the impeller's eye and other conditions are correct air should not get by the shaft packing.

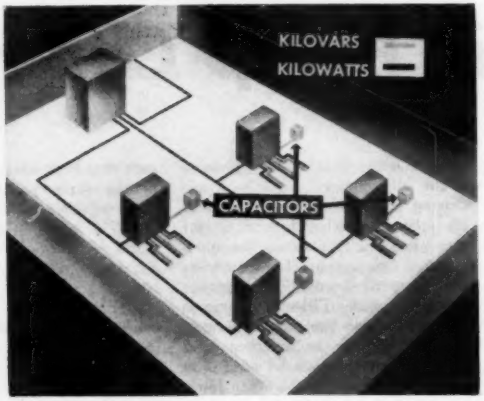
1 **I'M JIM SPARKS**—pleased as punch. Why? Well this month's power bill is 400 bucks lower than usual



2 **WE BUY ALL POWER** from local utility. Checking past bills, I found we paid $5000 yearly for low pf



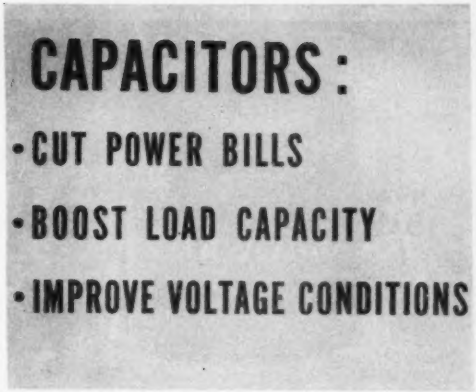
5 **NEAT STACKS** of capacitors can be almost forgotten once installed. Occasional dusting is all maintenance needed



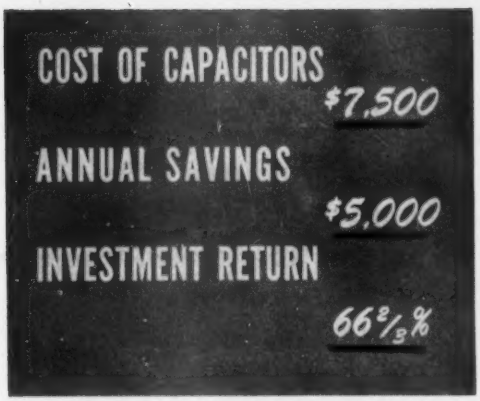
6 **WE COULD PLACE THEM** near load. (Boss is weakening . . . but he's not sure . . . I better explain capacitors!)

How To Sell Capacitors To Your Top Management

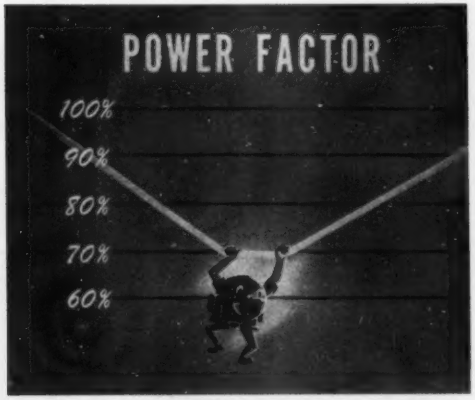
Many utilities charge extra for low pf. Jim Sparks in Toronto, Canada, saved $5000 yearly by installing capacitors. So, with General Electric Co sketches, Jim shows how he sold the boss



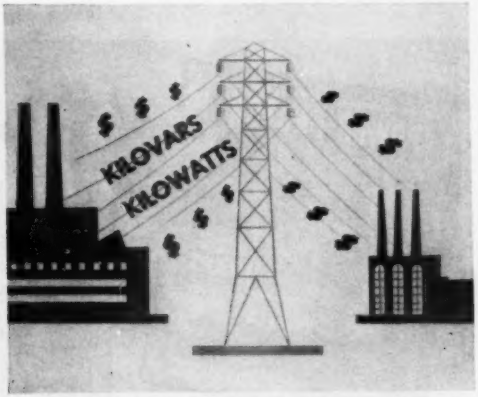
3 **WHEN NEW MOTORS** dropped plant pf under 70%, I ran to the boss with reasons why we should install capacitors



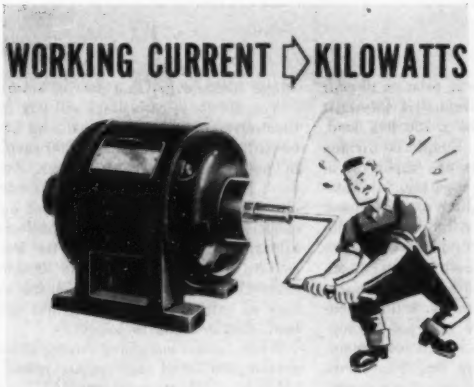
4 **HOW MUCH?** Well in our case about $7400 installed. But after in we save $5000 every year. (Boss liked that!)



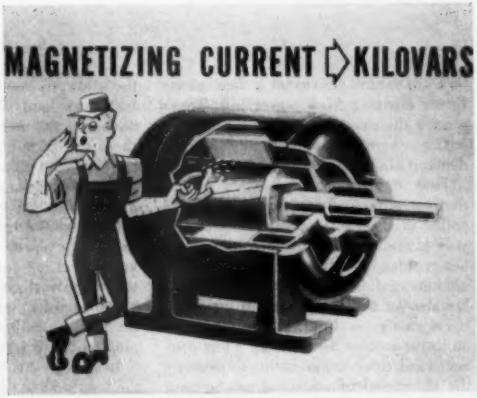
7 **WHERE INDUCTION MOTORS** are main load, pf probably sags. To understand pf, see what you get for each power $



8 **WE NEED TWO KINDS** of current; *working current kilowatts* for useful work, and *magnetizing current* for *kilovars*



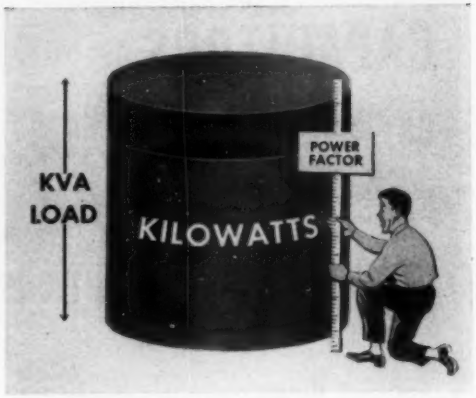
9 **WORKING CURRENT** actually powers equipment. This helps make up kilowatts registering on watthour meter



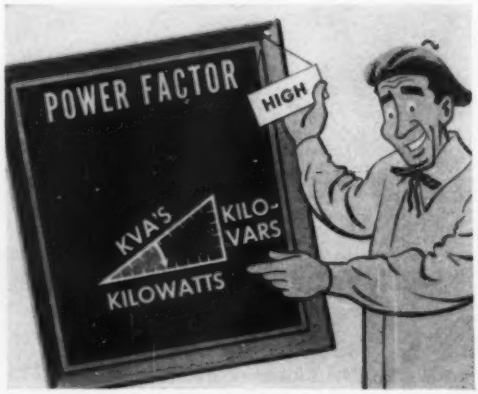
10 **BUT INDUCTIVE EQUIPMENT** needs magnetizing current too. Kilovars, doing no real work, are necessary

Continued Next Page

THESE SKETCHES SHOW WHAT PF IS, ALSO HOW CAPACITORS IMPROVE IT. LET THE BOSS SEE WHY HE'S BEEN LOSING WITH LOW PF. THEN PASS INFO ON TO THE YOUNG LADS ⟶



11 **PF IS RATIO** of kw to kva. Kva is volt-amps (÷1000) from utility. Kvar (volt-amp-reactive) is black belt above



14 **CAPACITORS SUPPLY KVAR'S** right in plant. It's expensive, because of capacitor cost, to try for 100% pf

15 **AT UNITY PF** kw equal kva. All plant kvar supplied by capacitors. Now add more load on same feeders

► GENERALLY SPEAKING a *low* power factor means a *high* power bill. That's always the case if you have a pf clause with your utility, like we did, or a kva demand clause.

First step. When it dawned on me that capacitors could save real dollars I called in my utility power salesman. He was glad to talk it over. And I got a better idea just why his company is anxious that we keep our pf high. This lad also set me straight on our metering.

For instance, kilovars don't register on kw-hr meters. So to set up a fair pricing yardstick, some utilities measure the amount of kilovars you use by your pf. If you require too many kilovars you're actually paying for a poor pf.

Pf is merely a yardstick to measure the kilowatts you use in relation to your total kva load. Therefore if kilowatts make up 80 units of a 100 kva load, then your pf is 80%. Simply 80 divided by 100. And kilovars are important in figuring pf because together, kilowatts and kilovars make up the total kva load.

Investment Angle. After chinning with the utility power salesman I wanted to know what it would cost to have capacitors supply those kilovars. It came to $7500 completely installed. A little mental arithmetic showed we'd get a whopping 66 2/3% return on our investment.

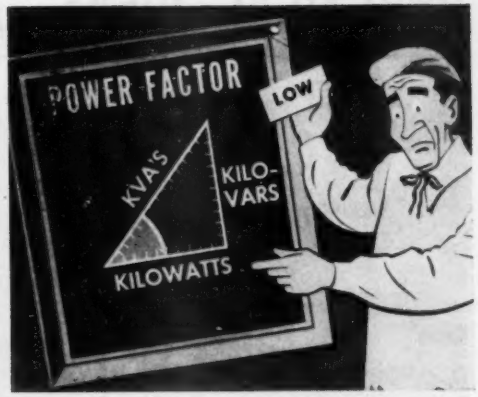
It was at this point that I tore into the boss's office. And after doing as outlined in the above sketches the boss gave the okay. He said he had a lot of places to put that money but none where it could get that sort of return.

Yes, sir, those capacitors will pay for themselves in just 18 months. And better still, we get that same $5000 saving in power costs year after year. And don't forget that kilovars on our feeder circuits had tied up nearly 1/3 of our electrical capacity. Now with capacitors, kilovars are supplied right at the load centers. About all our main feeders carry now is kilowatts. That means we have an extra 30% of capacity for new loads that are sure to come.

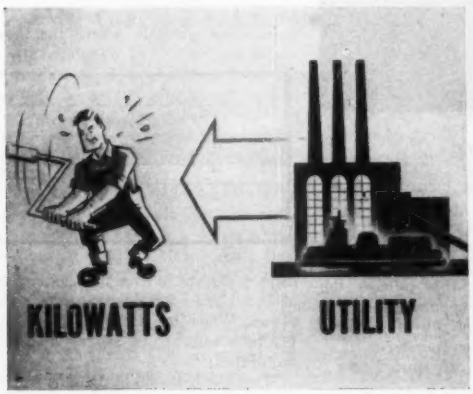
What's more, our plant voltage is improved now. And that means motors, lights and other equipment run more efficiently.

Other Installations. As an operating engineer who never likes to drop anchor

12 **DON'T ADD KW TO KVAR** to get kva. But do add as legs of triangle. Aim is to reduce kvar from utility



13 **SHIPPING KVAR'S** from utility cuts kw output. That's why penalty charge. But you need kvar's too!



16 **UTILITY BENEFITS** if they supply only kw's; get more kw's from generators plus more power in feeders

17 **AFTER CAPACITOR COST** match savings on power bills and added plant feeder capacity, you save real $$

too long in any one plant, I keep abreast of what's going on in many plants around the country (Canada and South America included!). Here are some other capacitor installations that I noted in my wandering diary . . .

. . . Pf was boosted from 57 to 96% at the Inman Poulsen Lumber Co in Portland, Oregon. This meant a saving of over $3500 every year. And that figured out to a steady return of over 35% on every dollar invested.

. . . Annual return was over 63% at the Apex Smelting Co in Cleveland. There a capacitor investment of less than $3000 pays off more than $1800 a year. . . . A sweet looking job went in at the Flintkote Co in New Orleans. The bill for the capacitor equipment was $1600. It will have paid for itself in little more than 20 months. The investment return in this case was 60% year after year.

. . . Then there was a batch of smaller units put in at the North Western Hanna Fuel Co in Duluth, Minn. This capacitor lineup saves $170 every month on the power bill by raising pf to better than 85%.

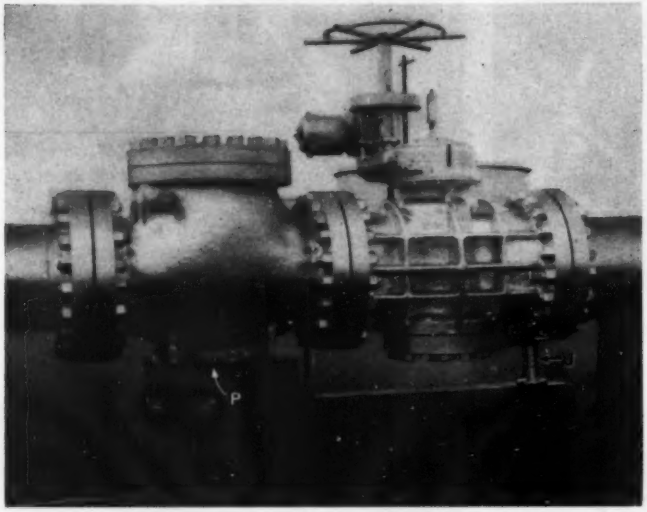
. . . In the West Stanislaus Irrigation District at Westley, Calif., they've saved $25,703 to date! And the operating engineer there says "The capacitors should continue to earn approximately $20,000 per year over a long period."

. . . And a lot of fellows mention other important advantages when you start talking about their capacitor installations. For instance, "removed 54% overload from transformers" . . . "boosted feeder capacity 31%" . . . "permitted additional motors, totaling 700 hp, to be added."

. . . Oh yes! Let's not forget the Old Dominion Iron and Steel Co of Richmond, Va. They boast of a 60% return on their capacitor investment. They were originally installed to get a 30% return on the power bill. But it turned out that the capacitors raised the voltage level to allow better, faster welds, hence increasing production.

Well I've said my little piece about capacitors. I think they're good; no moving parts; they'll last almost indefinitely and you can mount them anywhere—on walls, ceilings or on floors.

PRACTICAL IDEAS... *here's the trading post for your*



JACK SUPPORTS HEAVY VALVE

IN A CHECK-AND-GATE-VALVE combination, the check-valve body was mounted on a steel plate *P* to allow for expansion changes, as in the photo. To put the valve's weight on the foundation, jack-type support *J* forms a saddle to fit the valve-body flange.

In this form of mounting, the companion flanges of check and valve hold alignment of their junction and support that end of the long valve body. Adjustment of the screw jack gives uniform spacing between the adjacent flange faces to prevent misalignment strains.

A mounting like this relieves the pipe-line ends from supporting the valve body. If vibration occurs in the line, valve bodies are not overstressed.

ELTON STERRETT *Houston, Texas*

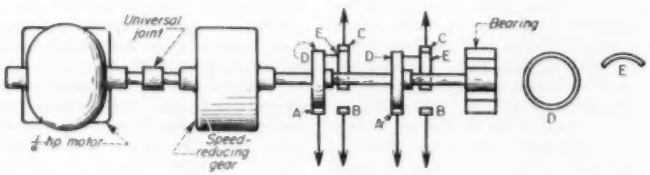
REPAIRS REVERSING-SWITCH CONTACTS

THE REVERSING SWITCH on two motor-driven washers in a laundry failed. The contacts on this switch are slowly rotated by a motor through a reduction gear. Contacts *D* are complete circles on which contacts *A* ride continuously. Circuit-breaking contacts *E* form about one-third of a circle and they are attached to *D*.

As the shaft slowly rotates, segment *E* picks up contacts *C* or *B* to complete a circuit through the reversing-switch coils. When the circuit is completed through contacts *A* and *C* the switches close for rotating the washers in one direction. Closing contacts *A* and *B* reverses the washer motors.

Contact segments *E* were so badly burned that they could not be repaired so we cut them free of *D*. From two pieces of brass bar ½ in. wide by 4 in. long we formed two new segments.

After the mating surfaces between *D* and *E* were made smooth and tinned we clamped the two together. Then with a torch we heated them, keeping the clamp tight. When the solder flowed and the clamp was tight we let the joint cool. This repair has stood up well. Now a new contact or replacement is easily made.

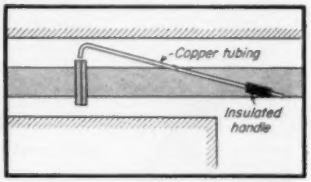


A L SHEA *Springfield Gard., N. Y.*

Copper Tube Quickly Finds Steam Leaks

AS A FIELD ENGINEER for a turbine builder I often have to find steam leaks in the hard-to-get-at spots. A strip of rag on the end of a long rod makes a simple tool for this job. Hold the rag near where the steam is leaking. Fluttering of the rag wil loften quickly pin-point the leak.

In close quarters where there are many pipes, steam from the leak may be deflected and seem to come from many places. When this happens I use a copper tube bent at one end as shown in the drawing.



When the bent end of the tube is near the leak, steam comes through the tube to where it can be seen or heard. Also condensate leaks from the low end of the tube. For high-pressure leaks take care that the end of the tube is not pointed toward someone.

Insulate a section of the tube for a handle, as in the drawing. One end of the tube is bent as needed for the job at hand.

C H SWENSON *Jersey City, N. J.*

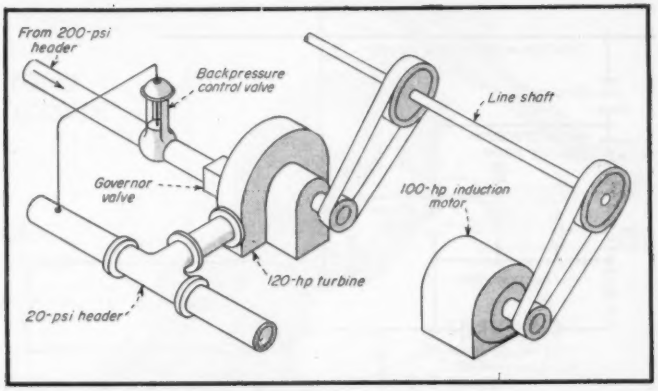
Bowling Alley Pins Make Good Mallets

WE BUY OLD bowling pins and turn them down to different sizes. They make good mallets. We use them on our salt dryers to strike the baskets and loosen the salt. There are many places too around the plant where wooden mallets are used. This little kink gives an easy way to make them.

GILBERT LINDGREN *Troy, N. Y.*

...operating and maintenance short cuts

FRED ANNETT, *Associate Editor*



TURBINE BACKS INDUCTION MOTOR

LOAD INCREASED on a lineshaft in our plant until the 100-hp driving motor got too hot. We needed more power but had only a 120-hp steam turbine. Use for turbine 20-psi exhaust did not match the load on the lineshaft. So a lot of exhaust would be wasted.

We licked the problem by hooking motor and turbine to the shaft, as in the drawing. This gave us in effect a dual drive. Low-pressure steam needs limit steam flow through the turbine as regulated by a back-pressure control valve.

Turbine develops what power it can with the varying steam flow. The motor governs the speed of the drive and supplies the extra power as needed.

When turbine output exceeds lineshaft load, the motor still regulates speed by operating as an induction generator. The turbine governor, set for a speed about 8% above rated motor speed, keeps the turbine throttle valve wide open normally. This allows the backpressure valve to regulate steam flow under normal conditions.

If the motor trips out, or is disconnected from the lineshaft, the turbine governor takes over automatically. Turbine then carries the load at higher speed.

As a generator the motor is not very efficient, but we have generated 50-kw byproduct power. Incidentally, the electric utility company, whose contract normally forbids tying customers' generators to its line made no objection to the induction generator. This type does not attempt to control frequency like a synchronous alternator does; hence it does not upset system balance.

W TAMLYN, JR *Flushing, N. Y.*

Poor Star Connection Upsets Motor Operation

A 15-HP, 3-phase motor became temperamental. Sometimes it would start and run at normal speed. At other times it would not start until given assistance. Also, the motor's speed was normal at times, then it would slow down. We put an ammeter in circuit and found the current varied widely, even though the load was constant.

This indicated that conditions in the power circuit had to change. The most likely cause of the trouble was a loose connection. After checking about every part of the equipment we found the star connection of the stator winding badly burned.

The connection was in a condition such that at times the motor operated three phase. At others, vibration caused one phase connection to open and the motor ran single phase. This uncertain contact could cause any of the effects observed. When the connection was cleaned and tightened the motor started and ran at constant speed. All of which again emphasizes the need for keeping a close check on your electrical circuit connections.

C A ARMSTRONG *Chicago, Ill.*

Clean Your Shoes in This Plant or Stay Out

MANY ENGINEERS object to mud being brought into the plant on people's shoes, just as a good housekeeper objects in the home. When a power plant is in the country, mud on workmen's and other's shoes that come into the plant makes it hard to keep the plant clean.

Not only does mud look bad, on the floor, but it gets crushed to an abrasive

dust and blown into the air. From here it settles on machinery and must be cleaned off. Worse still, it gets into the bearings or between other moving surfaces and causes serious wear.

To avoid this, the engineer in one plant put boot scrapers near all doors. To make them easy and safe to use, each had a high loop made of ½-in. pipe as in the photo. The lower ends were welded to the scraper blade set in concrete with the loop *L* extending up within easy reach.

With one or both hands holding the loop, a man is sure of his balance and can better direct his effort to cleaning his footwear. In this plant the chief accepted no excuses for coming in with dirty shoes.

ELTON STERRETT *Houston, Texas*

Makes Recorder Charts Do Double Duty

THE MAIL and parcel-post embargo stopped delivery of flowmeter and other daily recording-instrument charts. To meet this shortage we hit on a plan that gave us comparison data on steam and water flow and power generation.

Some of our recording instruments

(MORE PRACTICAL IDEAS NEXT PAGE)

use either red or green indicating ink. We stretched our available supply of charts by using those of the preceding day on the next with a change in ink color. These charts gave us a clear picture of two days' operation on one. We could closely check one day's operation against the next.

While this was an emergency plan and not a "pinch-penny" scheme we found that it has interesting possibilities where you wish to compare one day's operations directly with another.

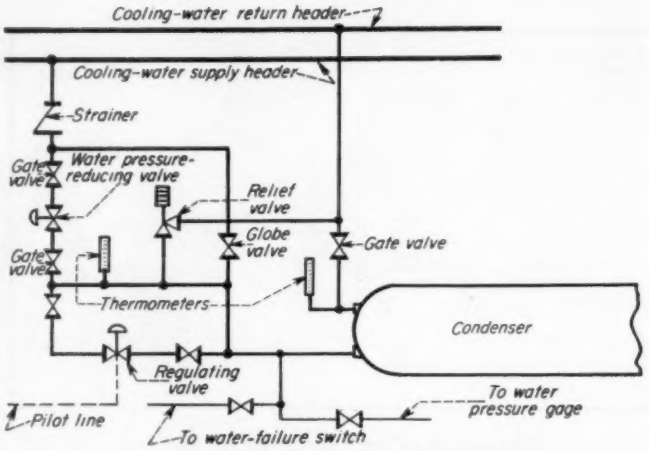
L W FITZPATRICK *Jefferson City, Mo.*

Old Ball Bearings Make Pipe Supports

HEAVY PIPE is hard to rotate when threading, cutting or welding unless

properly supported. We have found that discarded ball bearings make low-friction supports on which the pipe turns easily, as in the photo. The inner races are welded to the support, while the outer ones are free to roll with the pipe.

OLIN L BRAGE *Oroville, Wash.*



DUAL BYPASS OR CONDENSER

IN OUR PLANT we use pressure water for our refrigerating condenser. This installation required a water-pressure reducing valve and water-flow regulating valve. So that these valves can be properly maintained while the condenser is in service we installed the dual bypass in the diagram.

This hookup makes the system flexible. With it either the pressure-regulating valve or the water-flow regulating valve may be bypassed and taken out of the line. Both valves can also be bypassed and water flow controlled by hand.

This system has been in service for about three years and works fine. It is an ideal hookup when salt water us used for cooling.

S R HIGGINS *Long Beach, Calif.*

Half Couplings Serve as Trap Connections to Tank

SEVERAL welded-iron condensate receivers needed more trap discharge connections. The receivers could not be taken out of service long enough to do a good welding job, so we did as follows:

Regular tank-welding flanges could not be readily obtained and we made connections from pipe couplings. Selecting the right size coupling for the connection we cut it in two in a lathe. We then beveled the cut ends to allow brazing metal to flow under.

After marking the tank's side where a connection was to go we put a half coupling there and brazed it in place. It would be difficult to weld a flange on the side of a tank, but we brazed connections on several times and always got a good joint.

When the half coupling had been brazed on we took off the manhole cover. Placing a bucket under where the hole was to be made, we cut out the receiver wall inside the coupling. The coupling served as a guide for the cutting torch tip to get a true circle.

By proper handling of the cutting torch, threads in the coupling were not damaged. The bucket containing the burned metal was taken out of the receiver and the manhole closed. Then as soon as the trap discharge was connected to the inlet, the receiver was put back in service.

O C MILES *St Louis, Mo.*

Increased Engine Speed Stops Governor Noise

A HIGH-SPEED shaft-governed engine, directly connected to a generator, was noisy under peak loads. Inspection of bearing and other parts of the governor did not show the cause of the trouble. Due to the noise a smaller unit was used during peaks to help carry the load, which increased steam use.

Generator's nameplate gave speed as 250 rpm. We checked the engine's speed and it was only 238 rpm, about 5% low. After midnight we stopped the engine and tightened the governor spring to get rated speed.

The next night the engine did not pound except near the peak of the load. This gave us a clue, so we adjusted the governor for about 5% over speed. This higher speed reduced the cutoff so that the governor kept off the stop and the noise ceased.

H P CLEARY *Atlanta, Ga.*

(MORE PRACTICAL IDEAS NEXT PAGE)

TEMPERATURE VARIATIONS, ABRASIVE SCALE NO PROBLEM WITH Edward BLOW-OFF VALVES

EASY OPERATION
Big knobbed handwheel, easy to grip even with oily hands.
LEAKPROOF BONNET
Welded integral or bolted, Edward blow-off bonnet joints won't leak.
PERFECT ALIGNMENT
Single set-up machining assures alignment of working parts.
ADJUSTMENT SIMPLE
Packing adjustmenteasy with through-bolted gland.
WEAR RESISTANT
Alloy seats and disks Stellite hard faced. (Stainless steel in lower pressures)
STREAMLINED
Nothing to prevent scale being blown completely through valve.
EQUALIZED CROSS-SECTIONS
No irregular masses of metal to distort on heating and cooling.

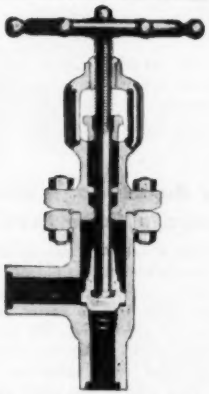
The vicious punishment of blow-off valve service—abrasive action of grit and scale—severe strains caused by violent temperature swings—finds its match in Edward blow-off valves.

Special hard surfacing equipment, developed at Edward, prepares seats and disks for a long life of resistance to the grinding wear of sediment blown through the valve at high velocities.

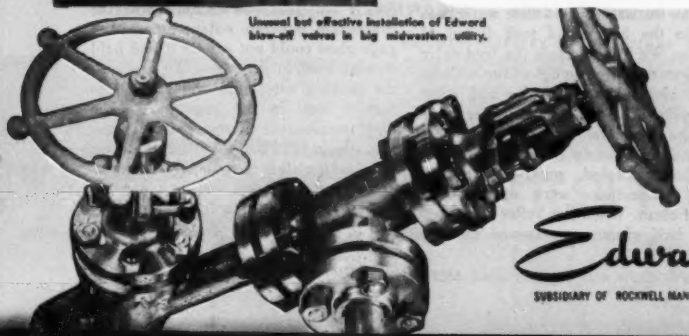
Metal sections of Edward blow-off valve bodies are engineered to compensate for the thermal distortion so that a valve closed tight under high boiler temperatures is still tight after cooling.

LOW MAINTENANCE
PIPING FLEXIBILITY
SLOW OPENING
EASY REPACKING
TIGHT CLOSURE
LONG LIFE

Unusual but effective installation of Edward blow-off valves in big midwestern utility.



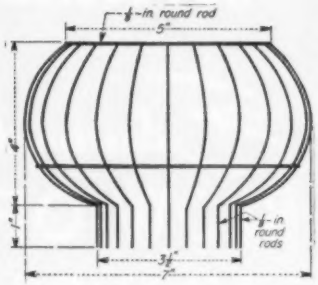
Typical Edward angle bolted bonnet blow-off valve. Choice of straightway or angle designs gives maximum piping flexibility.



Edward builds blow-off valves for 150 lb to 2500 lb boiler service. Write for Catalog 12-D.

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO EAST CHICAGO, INDIANA



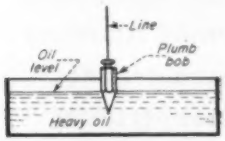
Protect Roof Drains With Proper Screens

WHEN ROOF DRAINS plug up with debris, water is likely to overflow into the building and cause serious damage to valuable machinery and materials. The frequency with which this happens emphasizes the need to protect these drains with strainers. After failing in several attempts to get suitable screens for large drains we made them, as in the figure.

The bars are made from ⅛-in. round iron. These are all the same shape and can be readily formed on a template. Each strainer has 24 bars. The top circle is made from the same material as the hoop.

The bars are assembled in a template made from a piece of board with 24 3/16-in. holes bored in it on a 3½-in. circle. The bars are then welded to the top circle, then the loop is raised and welded to the bars. We have used these for several years and feel that a properly made and installed screen is as important as the drain to insure operation of the latter.

A L SHEA
Springfield Gardens, N. Y.

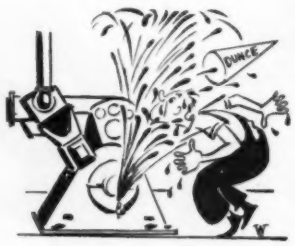


Oil Pot Takes Swing Out of Plumb Bob

BECAUSE OF vibration, air currents and other causes, plumb bobs may swing from a true vertical. This is objectionable when taking accurate measurements. An old trick to prevent this swing will bear repeating here. Let the bob hang in a container of heavy oil. This trick was told me by an old erector, but it was new to me and no doubt will be to others.

GILBERT LINDGREN *Troy, N. Y.*

My Biggest Boner



► I WAS CHECKING the oil level in one of our 15-hp compressors. I removed the plug and started to read the level.

Suddenly oil started gushing up out of the hole right into my face. The compressor had started up. Believe me, I was soaked from head to foot. She usually held about 5 qt of oil, but by the time I could get her shut down, she didn't have over 2 qt in her. The rest was on me and the ceiling.

Now there's one rule I'll never forget. When I start checking the oil level in a compressor, I always double check to see that the switch is off—DALE WARNER.

Why Boiler Gage Glass Showed a False Level

THE GAGE GLASS on a new boiler after four months operation suddenly showed low water. As the boiler load was fairly constant there was no reason for wide changes in water level. We knew the feed line to the boiler was clean and the regulator feed valve was partly open, as it was on the other units.

On the water column a single alarm whistle was operated by a high- and a low-water float. The whistle continued to blow so we assumed that water was low in the boiler and took it out of service. We did not close the feed valve and water soon came out of the whistle.

We closed the feed valve and when the boiler cooled to 50 psi, water came into the gage glass. As the boiler cooled, water level went up in the glass. After the boiler cooled, water-column and glass connections were opened and found clean. When the boiler was filled to a half glass, we removed the top from the water column and the water level in column and glass checked.

When the boiler was fired and steam pressure increased, water level in the glass dropped when it should have risen. Try cocks on the water column showed that the water was rising as it should, while the level in the glass continued to go down. Water level continued to rise in the water column, even though it went down in the gage glass, until the alarm whistle blew.

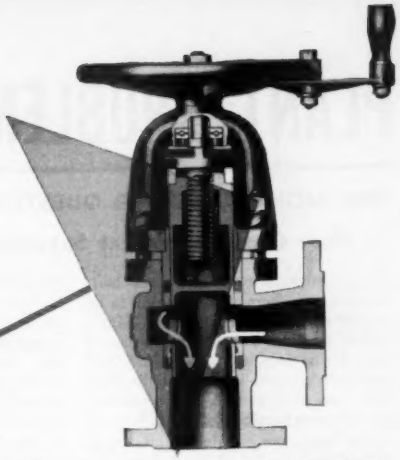
When the boiler was piped up, the ⅜-in. drain from the gage glass had been connected into the ¾-in. line from the water column just below its blowdown valve. This hookup looked neat but was the cause of the trouble.

When we disconnected the two drain lines we found the ⅜-in. valve leaking badly. This leak was so much that the connection between water column and gage glass could not supply it and hold normal level in the glass. We replaced the leaking valve and water came to correct level in the gage glass. The high temperature of the ⅜-in. connection should have indicated that the valve was leaking. But as none of us had an experience like this before we overlooked this bet at first.

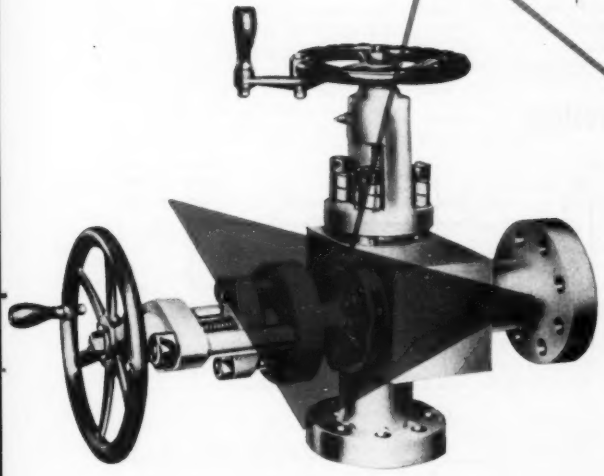
C R ANDERSON *Richmond, Va.*

OVER 15,000 BOILER PLANTS USE THESE BLOW-OFF VALVES

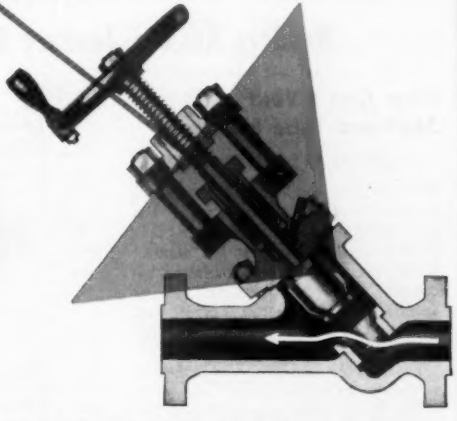
MADE FOR EVERY PRESSURE



This is the famous Yarway *Seatless* Blow-Off Valve. Balanced, sliding, nitralloy plunger design eliminates seat—a common source of wear, clogging and leaking. Type B (above) for pressures 50 to 400 psi, angle or straightway, single or tandem. Other types available for higher pressures. Complete description and specifications in Bulletin B-424 for pressures to 400 psi, or Bulletin B-433 for higher pressures.



The Unit Tandem—Yarway's finest blow-off valve for high pressure service. Combines a Hard Seat Valve (for blowing) and a Seatless Valve (for sealing) in a one-piece forged-steel body, flanged or socket welding ends. Also available combining two hard-seat valves. For pressures to 2500 psi. See Bulletin B-433.



This is Yarway's Stellite-Seat Valve for pressures to 2500 psi. Shown here in open position. Disc and seat ring are stellite-faced and carefully mated for tight seating, long life and hard wear. Angle or straightway, single or tandem combinations (hard seat—hard seat or hard seat—seatless) available. Complete specifications and description in Yarway Bulletin B-433.

YARNALL-WARING COMPANY • 100 Mermaid Avenue, Philadelphia 18, Pa.

BRANCH OFFICES IN PRINCIPAL CITIES

PLANT PROBLEMS *put your know-how to work. . .*

THIS MONTH'S *POWER* QUESTION:

How Can We Protect Superheaters During Starts?

WE'RE PLANNING to install several boilers on a job where they will have to be banked and restarted frequently. Superheaters are to be pendant, nondrainable type. Steam pressure is 400 psi, 700-F total temperature. Boilers will be fired with spreader stokers and furnaces are completely watercooled.

Now here's our problem. Units could be started rapidly if there were no danger of overheating the superheaters. If they aren't cooled properly we may burn them out. While warming a superheater we can't take saturated steam from the boiler.

Steam at 250 psi saturated is available from another source when starting the new boilers. What we'd like to know is this: Can saturated steam from this other source be passed through the superheaters of the new boilers while they are being restarted? Will this steam protect superheaters in the new boilers? What piping arrangements are suitable for connecting an existing 250-psi header to the superheaters of the new boilers? Are special safety precautions and valving arrangements needed? Will rapid starts overstress drum steel?

We'd appreciate having reader's opinions and details of their experiences with similar jobs. Piping sketches would be most helpful, too.—*ER*

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers with sketches or photos command extra pay

Readers Answer January Question

How Can I Vent Shell-and-Tube Heaters?

(This question from the January issue is followed by best answers from readers.)

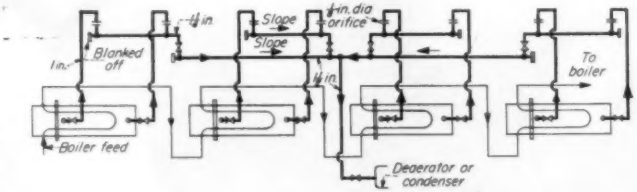
We have four shell-and-tube feedwater heaters in our new power plant. Put into operation about a year ago, they worked well for the first few months. Lately, though, they've been losing capacity. Water temperature leaving heaters, see sketch p 130, *Jan,* POWER, *is* 10 *to* 30 *F below normal, sometimes more.*

I believe the heaters should be vented to remove gases and other noncondensables. Some of the gang agree with me, but others say scale causes the trouble, not noncondensables trapped on steam side of shell.

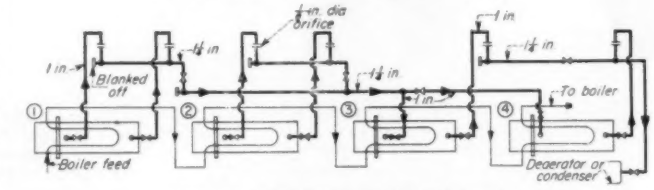
Now what I'd like to know is how and where these heaters should be vented, where vent lines must be connected for best results, what valves are needed, how a vent header serving all heaters can be sized, and where vent piping must terminate to discharge noncondensables. Sketches of good piping hookups will be helpful.—HB

Practical Piping

IT SEEMS THAT *HB* has both a scale and venting problem. Use acid cleaning for scale removal. To vent heaters, locate one connection on tube-sheet shell side, another near opposite end, both at center line of shell as in sketch.



Vent system for four heaters at or near same shell pressure



Vent system for two high-pressure heaters (1,2) and two lower-pressure heaters (3,4)

We've found 1-in. connections good for all our high- and low-pressure heaters. Connect the eight vent lines to a common header. Stainless-steel orifice, 1/8 or 3/16 in. diameter, in each vent line reduces steam wastage by increasing the resistance to its flow. Connect header to lower pressure region like condenser or deaerator. Sketch *A* is for heaters operating at or near same shell pressure. Sketch *B* shows piping for heaters operating at two different pressures. Orifice with 3/8 in. hole is best for heaters at less than 14.7 psia.

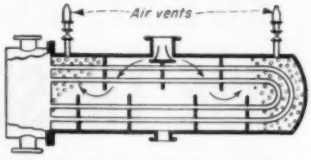
Use enough valves so one or two heaters can be isolated. Pitch heater vent lines towards header and pitch this toward vent receiver.

Also, check heater drainage equipment. Level controls may not be functioning properly or they might be undersized.

A J BREUGELMANS *Hoboken, N. J.*

Scale No Problem

I DOUBT IF SCALE could be trouble because heat exchanger is acting as a heater, not an evaporator. Manufac-



Heater Fouled

FOULING AND LACK of proper venting cause trouble. This is shown by satisfactory operation for first year. Use thermostatic vent as in sketch, one for each vent line.

J M THOMPSON *New York, N. Y.*

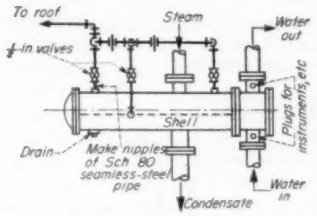
Drill Vent Holes

NONCONDENSABLES must be vented; drill vent holes in top and side of heater for this. I suggest use of 3/4-in. couplings welded to shell before holes are drilled. Of course, if holes are in shell, use them without drilling others.

CLYDE G HOWARTER *Canton, Ill.*

. . . help the other guy cure his headaches

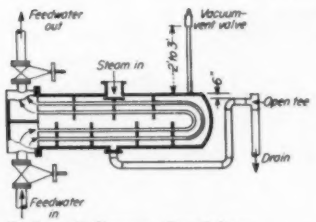
TYLER HICKS, *Assistant Editor*



turers always provide vent connections for feed heaters. Secure heater drawing and from it locate vent openings. Screw plug usually protects them during shipment. If drawing isn't available, remove from shell all screw plugs that open into steam space and are at or above middle of shell. Shut off steam and water before doing this.

Fit nipple of proper schedule number, valve and vent pipe to each connection. Forged-steel instrument-type globe valves of suitable pressure rating are best. After connecting vents, test heater. If OK, fit others the same. Pipe to permanent outdoor vent pipe if steam pressure is greater than atmospheric; see sketch.

A M PALMER *Brooklyn, N. Y.*



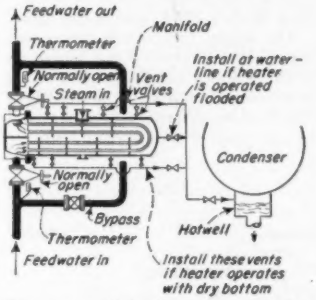
Solved Same Problem

IN OUR PLANT we (1) checked tubes in heater for leaks (2) trapped heater drain and (3) installed vent line at heater end; see sketch. Vent-pipe size should be 1 in. and vent valve of vacuum-vent type.

F RAPHAELIAN *Millburn, N. J.*

Good Vents Pay Off

INCREASE HEAT TRANSFER and reduce corrosion by proper venting. Noncondensables enter heaters several ways. Leakage into heaters operating at less than atmospheric is one common source; organic matter in makeup, condenser-tube leakage and imperfect removal of air and gases by deaerators are other sources. Noncondensables collect at top of shell or near heater condensate, depending on their weight, greater or less than steam. So vents in both places may be needed. In fact,



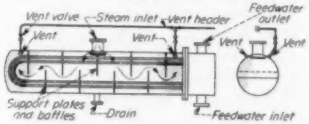
they are needed wherever gases may collect.

Sketch shows one way of installing vents. Top vents are essential. Use lower ones if heater isn't operated partially flooded. With partial flooding, locate vent at heater end above water-line. Lower baffling may prevent good operation of this vent.

A W SHEPHERD *San Diego, Calif.*

Vent Tips

LOCATE VENT CONNECTIONS in top portion of shell of horizontal heaters; sketch. Spot one vent between end of heater shell and last uppermost baffle. Other is between last highest baffle and tube sheet. Use ½-in. vent for medium-

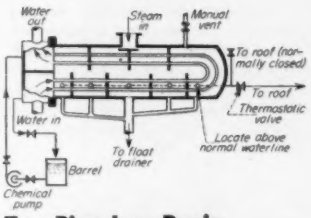


size heater. Same size steel gate valve, or a ¾-in. steel gate valve may be used in common connection after two vent lines join. Drill small hole through gate in each valve. Increase hole size if pressure drop from heater to lowest pressure point is such that steam flow is not greater than 5 lb per hr. Use Napier's equation for figuring.

Lowest pressure point can be upper part of deaerating heater or air-removal portion of condenser. With heaters in series, cascade vents to lower pressure heaters. Open vent valves wide when starting heaters; close after all gases and noncondensables are removed.

Improper operation or sizing of drain control valve may cause the trouble. To check, install gage glass across normal operating level in drain-valve float chamber. If valve is too small or pressure drop across it insufficient, drains may be backed up in heater shell, and a portion of heating surface flooded.

P G NOVITZKY *New York, N. Y.*



Try Pipe-Leg Drain

WITH BAFFLES as shown in *HB's* sketch, use pipe leg to drain condensate from all sections. Vent air through thermostatic valve to atmosphere if pressure in heater is greater than atmospheric. See my sketch for details.

Clean water side with inhibited acid for good results. Consult water-treatment specialist for acid to be used.

MELVIN EVANS *Chicago, Ill.*

Use Flash Tank

VENT EACH HEATER separately and run to a flash tank. This recovers heat in vented gases and steam.

B D RILEY *Brunswick, Ga.*

EDITOR'S NOTE: Some answers to *HB's* question suggest venting his heater to the atmosphere using a thermostatic vent valve or trap. Past experience shows this isn't too common a practice. Vent lines are generally run to the next heater operating at a lower pressure, or, sometimes, to the air-cooler section of the main condenser. Also, certain manufacturers recommend use of a small orifice that bleeds continuously instead of a trap on their heater vent line. Size vent lines in accordance with manufacturer's instructions; increase header size as volume of vents becomes larger. Before using any suggestion recommending venting a closed heater to the atmosphere, consult heater manufacturer. He knows best for his unit.

READERS

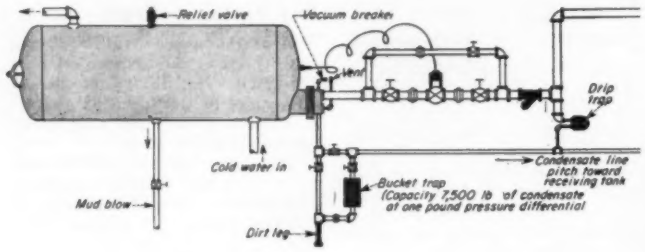
BECAUSE we have combined *Power*'s "Problems From the Plant" with *Operating Engineer*'s "Plant Problems", we have more good answers than we have room for. We've even had to leave a few interesting answers out of this issue. So this month, we're holding off new questions to be answered. *OE*'s problem on next page.

More PLANT PROBLEMS

WHY WON'T HOT-WATER TANK HEAT WATER?

WE BOUGHT *new hot-water heating equipment and installed it ourselves. The entire system cost well over $2500, including labor. It has a 43-in. dia by 192-in.-long hot-water storage tank. Tank has heating element in bottom that's supposed to heat 2000 gal per hr from 40 F to 180 F, with 15-psi steam.*

The heater, trap, thermostatic valve, etc are all the very best and hooked up as in my sketch Jan OE, p. 62. Trouble is we cannot get water in heater above 120 F. Also, there is a banging inside heating coils. What's wrong?—MI



Here's Manufacturer's Hookup

WE MAKE and assist design hot-water systems. Chief trouble with MI's system is improper condensate drainage. That's due mostly to trap being placed higher than steam-heating element. With trap placed as shown in original problem, element fills with condensate before condensate reaches the trap.

With only 15-psi steam entering heater, a trap may not push condensate up hill because pressure at trap may be almost zero. This is especially true in water-storage heater where every bit of steam entering element is often condensed. To prove, place gage before trap. That will show any large pressure drop.

About 2500 lb of condensate will form per hour at rating shown. With a 3-to-1 safety factor, use trap with 7500-lb-per-hr rating at 1 psi differential.

First pipe up tank as in my sketch—I've added a drip trap to remove condensate from long steam line before it hits the heating coils. This relieves trap on discharge side of heating element of additional work. It also provides drier steam to element for quicker heating.

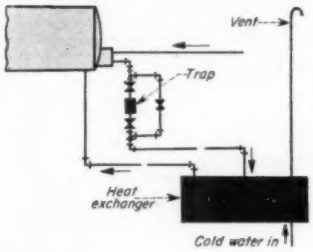
After installing trap as shown in my sketch, pitch return line down from trap all the way to vented receiving tank. Then equip heater with vacuum breaker, air valve, relief valve and temperature regulator shown. Blow sediment daily from tank. Foreign matter settles out when tank is not in use overnight.

F LANKOW *Patterson Kelly Co. New York City*

EDITOR'S NOTE: *These readers said about the same thing as Frank Lankow.*

E J HOWE *Pelham Manor, N. Y.*
A R ULLOA *Mexico, D. J., Mexico*
H A KAISER *Brooklyn, N. Y.*
W G GUNDAKER *Seagoville, Texas*
C A FREY *Chicago, Ill.*
W SWALE *West Hartford, Conn.*
A MOREAU *Detroit, Mich.*
M W BOXER *Bronx, N. Y.*
J E GLEASON *Plymouth, Mich.*
J P TURNER *Chicago, Ill.*
D WAID *Cincinnati, Ohio*
A LESCARD *Lowell, Mass.*
W R BARRETT *Bartlesville, Okla.*
S J MUCCIGROSSO *Pawtucket, R. I.*
G BENEDICT *Montpelier, Vt.*
C H ELBERT *Irvington, N. J.*
H BROWN *Albany, N. Y.*
J C KULIGUSKI *St. Marys, W. Va.*
H T LIVINGSTON *Los Angeles, Calif.*
L J DOBUCKI *Frederick, Md.*
J L JOANNETTE *Mackeyville, Que.*
A CANNON *Laurence Harbor, N. J.*
J WINN *Sillery, Quebec*
A R ECKERT *Mt. Vernon, Ill.*
T F CUNNINGHAM *Philadelphia, Pa.*
A H MOULTON *Pittsfield, Mass.*
F FENGER *Omaha, Neb.*
K HALLENBECK *Redlands, Calif.*
J W BONGARD *Flushing, N. Y.*
D L SHULTS *Bliss, Idaho*
T J FREEMAN *Gastonia, N. C.*
G H WELLS *Kansas City, Mo.*
S MORPHET *Chapleau, Ontario*
P L ALEXANDER *High Point, N. C.*
T H POWERS *Charlotte, N. C.*
W H MILLER *Lancaster, Pa.*
L MCDOUGALL *Detroit, Mich.*
J O'BRIEN *Syracuse, N. Y.*
F WHYTE *Chicago, Ill.*

EDITOR'S NOTE: In addition to agreeing *with Frank Lankow, these readers have further comments:*

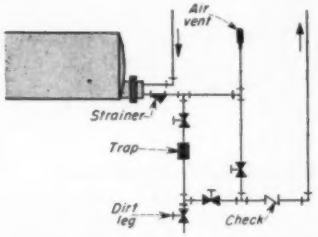


. . . Install heat exchanger, my sketch, to preheat cold water entering tank. Then incoming water will pick up Btu from the trap's discharge and cut down on steam used for heating water.

F D HOITT *Somerset Centre, Mass.*

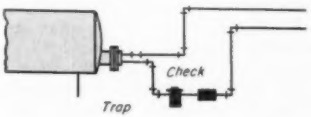
. . . If lowering trap and return system does not increase temperature to 180 F, open by-pass valve about one-quarter turn when starting. If this helps temperature rise, trap is too small or not working. Remember, what goes into heater must come out.

B D RILEY *Brunswick, Ga.*



. . . Install trap as in my sketch. Determine actual back pressure at trap with a gage. This is usually well worth the trouble.

H H DEMLING *Bronx, N. Y.*



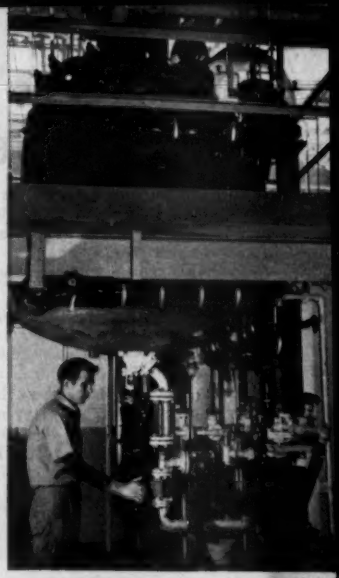
. . . If trap return must run up, install swing check, my sketch, after lowering trap. This will prevent condensate backing down to trap when regulating valve is shut off.

S M GRANT *Chicago, Ill.*

Chas. Pfizer & Co., Inc., is the discoverer and sole manufacturer of terramycin, the newest "wonder drug," which has proved effective in the treatment of *more than 50 acute infections.* Pfizer is the world's largest producer of antibiotics and a leading producer of synthetic Vitamin A.

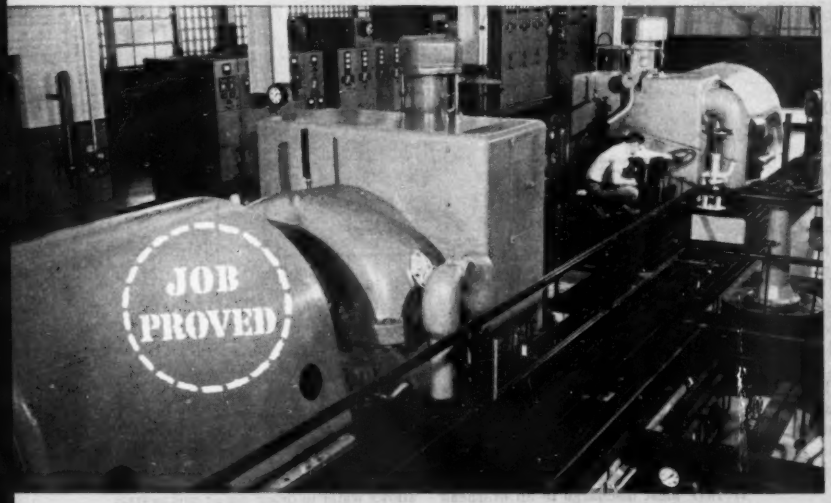
Power—lots of it and never failing—is needed by Pfizer's modern plant at Groton, Conn., to safeguard round-the-clock production. The plant relies entirely upon its two steam turbines for power, light, and refrigeration. For the utmost protection, "Job Proved" Sunvis 916 Oil was chosen as the lubricant for these turbines when installed—two years ago. This Sunvis 916 has been in continuous service ever since. As expected, inspections show the turbines free from rust, sludge, and corrosion; and laboratory tests show the oil ready for thousands of hours of continued service.

Sunvis 900 Series Oils are unsurpassed as turbine lubricants. Under normal operating conditions they will be *good for the life of your turbines.* For complete information, telephone the Sun Office nearest to you or write Department P-4.



THE EQUIPMENT pictured here is utilized in one of the stages of a complex process that Chas. Pfizer & Co., Inc., world's largest producer of antibiotics, follows in the manufacture of its new "wonder drug," terramycin.

POWER FOR "WONDER DRUG" PRODUCTION PROTECTED BY SUNVIS TURBINE OIL



TWO 2,500 KW TURBINES, each charged with 300 gallons of Sunvis 916 Oil, generate all of the plant's power. The condensing-extraction unit has been running over 15,000 hours, the back-pressure unit over 7,000 hours.

THE LUBRICATING OIL flows continuously through a layer of wool, then a tank of water, and finally a triple bag filter. Recent tests at Sun's laboratories show that the oil is in excellent condition, and good for thousands of hours more.

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SUNOCO®

More Plant Problems

. . . If tank is in cool spot, be sure to insulate it properly after lowering trap. That will cut down radiation and conduction heat loss.

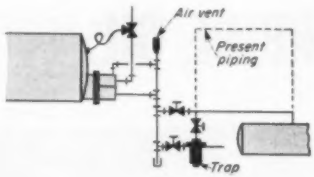
W C GIRTON *Evansville, Ind.*

. . . To check operation, after making changes, install gate valves in front of and beyond traps, with drip leg in front of trap—see if trap is too small by opening valve after trap. Heater may not be getting enough steam—check by valve on drip leg. Steam gage may not read right. Any congestions, such as supply valve partially shut, sludge in line, faulty trap, congestion or improper size of return line, are important. Better put a safety valve on heater before water gets hotter.

J E GRAMLICH *Pittsford, N. Y.*

Right Size Trap

CHANGE HOOKUP, my sketch. Condensate must flow to trap by gravity fast enough to keep coil at highest rate of condensate flow. Maximum condensation rate takes place during first few minutes when tank is full of 40 F water. Temperature difference between steam in coil and water in tank is greatest then. At 200 gal per hour heated from 40 to 180 F, condensate flow is around 2500 lb per hr. On starting with tank full of 40 F water, this may double or triple if coil is large. So trap must be large enough to handle flow or coil fills with condensate.



Select a trap with 5/8 or 11/16-in. dia seat orifice, with continuous flow rate of 15,000 lb per hr. This will handle 7500 lb, dumping half the time. Check coil for leakage by opening line between trap and heater. With water pressure on tank, any leakage will run out open drain.

S C PAGE *Buffalo, N. Y.*

Here's What Happens

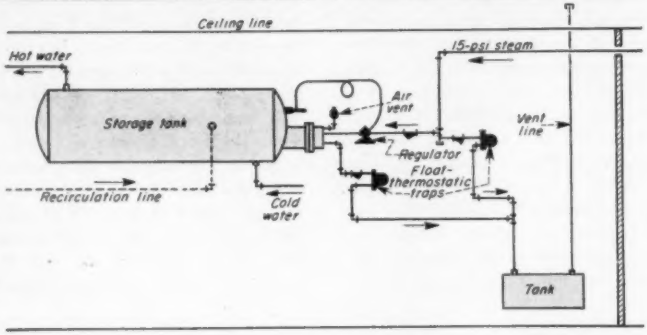
MI has vertical lift of 5 ft 6 in. after bucket trap and no check valve. Without a check valve, vertical condensate leg drains back into heater when temperature regulator has shut off and no pressure exists in heater.

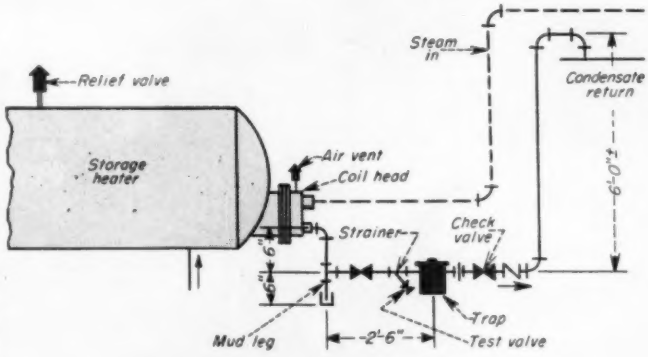
This vertical column of water has back pressure of about 2 psi, so if regulator is throttling type and partially closed off, at times this back pressure may be enough to stop all steam flow to heater. I show heater dripped with a combination float and thermostatic steam trap and return line falling to condensate tank. This gives smooth and continuous drainage of condensate from heater even when regulator is shut off, or partially throttled down. When regulator valve opens again, air is vented through trap and condensate is easily handled by this trap.

I also show a thermostatic air vent on head of the heater. This releases air rapidly from the heater on start-up and keeps air free at all times. During periods when regulator valve is shut off, this vent will cool and open, acting as a vacuum breaker. This allows any condensate in heater to flow out through the float-thermostatic trap.

MI did not show a recirculating line from building, so I include one. Exact point of re-entry is not too important, but it should not be too near the outgoing hot-water line. I show pipe-line strainers ahead of both traps and temperature regulator as protection against foreign matter.

C E BRAKENRIDGE
Western Springs, Ill.



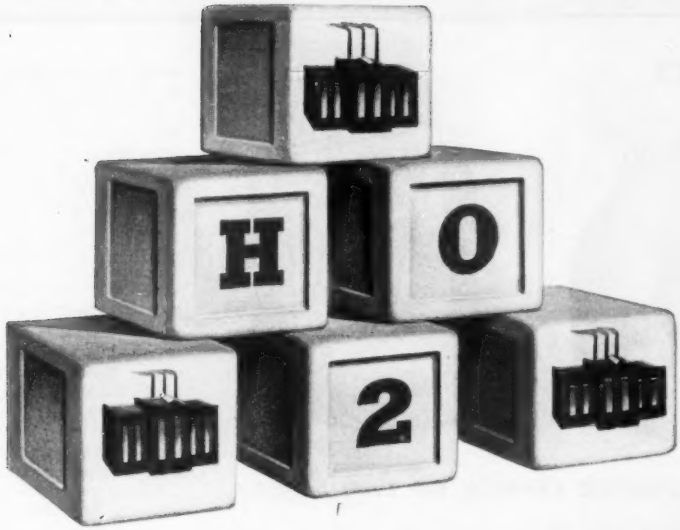


IF DISCHARGE CAN'T BE LOWERED

IF TRAP must discharge to an overhead condensate line, it should be lower than coil it drains. Water standing in coil does three things which directly affect the output of coil. First—it tends to cool the coil and the steam. Second—it cuts down the heat transfer area of the coil. Third—it makes a noisy installation and retards proper steam flow.

I suggest hook-up in my sketch. This allows water to drain out of coil to trap. Mud leg and strainer keep dirt out of trap. Check valve in discharge line prevents water from backing up into coil from condensate header. Have at least 2 ft 6 in. of uninsulated cooling leg ahead of trap. After rise in discharge line, it should drop into top of condensate header.

S R HIGGINS *Long Beach, Calif.*



HOW TO BUILD PROFITS!

WATER, which is a basic requirement of industry, is seldom suitable for use in its natural state. Adequate protection from the many hazards which accompany the use of incorrectly or inadequately conditioned water, whether for boiler, cooling or process use, is one positive way to increase plant efficiency . . . *and build profits!*

For over two decades BETZ has provided engineering guidance and developed control procedures for the correction and prevention of all water difficulties. If the results you are presently obtaining are not fully satisfactory, our nationwide staff of engineers welcomes the opportunity to discuss your water problems. Why not start building profits *today?* W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pennsylvania. In Canada: BETZ Laboratories Limited, Montreal 1.

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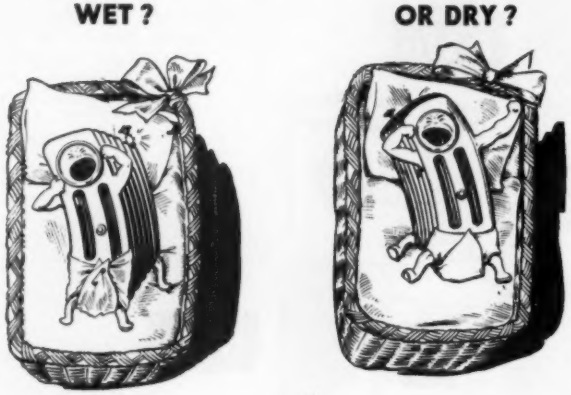
ARGUMENTS *here's the place to unload your gripes to . . .*



UNLIKE TOBACCO EXPERTS, NO TWO AGREE

CONNING THE INNARDS of Feb *OE*, p 60, shows quite a scrap over proper handling of water heating system during idle periods. I note nine replies, no two of them are even near twins. Readers seem equally divided on whether lines and radiators should be full or empty.

For those who prefer drained idle periods, I should point out the added disadvantage of having to vent every stubborn radiator when refilling. As much as 200 man hrs have been used in doing the job (160,000 sq ft "edr") on about 8,000 radiators. This adds an item of $300 or so to the $10 cost of water as quoted by Mr Elbert.

My experience has been that the water medium loses its virulence in attack on metals after a few months use at 200 F. Then it needs only to be disinfected against decomposition.

But the suggestion of Mr Spray regarding further treatment with an organic chemical to eliminate scale and corrosion sounds sensible to me. In my opinion less damage results from leaving water in the system than from emptying it so that oxygen can get in its dirty digs.

ALDO CLOSE *Quebec, Can.*

How Does a Chief Train Good Men?

IN DEC *Operating Engineer*, 1950, page 58, "Argument Corner," I find an article by Frank Sulzberger, Chicago, Ill, on training plant personnel. He would like his new personnel to have 11 years training at metropolitan vocational high school, a wish that is seldom fulfilled. Also a chief seldom hires help today though he may have something to say about it.

I doubt very much whether a chief in a modern plant has the time and patience to train his men from scratch. That is why, when answering an ad for a position, personnel are asked to state on application forms their special qualifications for the position.

Chief's time is valuable in the everyday routine of duties. He covers miles and has no end of complaints to listen to, aside from other duties too numerous to mention. Here, in other words, he has a job to do and he can buy experience on the open market if the wages are attractive. So why should he be saddled with inexperienced help and then be tortured by his conscience when he leaves plant at night.

By all means train from present personnel, but delegate this work to your assistant. It's more in his line of duty. Also lend him books and plant literature. Find out if he is interested in doing any more than his assigned job. How many hours a week does he spend studying plant or does he just go home and forget about it, figuring "it's the chief's baby—let him worry."

Mr. Sulzberger also states that if he gets one that isn't interested he gets rid of him fast. I think this is a bit rough on the lad, and why not find out why he's not interested? There must be something he's interested in. Find out where he fits in and place him there.

With our present union-labor code, chief engineers can't get rid of a man fast unless he is a detriment to company he works for. Of course, there are many ways of getting rid of a man, but you always have to watch your step.

In the training of plant personnel many other factors outside the scope of engineering must be taken into consideration. A chief must look at his own self. He should make an honest approach to the men. Treat them as men, not children. And don't listen to petty gossip. Avoid gripers like a plague.

How did you get chief's job—by your ability or by pull? Can you instill confidence in your employees? Actions speak louder than words. Do you promise everything, and deliver nothing?

A chief can either make or break a plant by his actions. That's why his superiors should be extremely careful in their choice of a man for this position because he is the funnel through which all personnel's ideas go before reaching the firm. A mere whim or a passing fancy or a dislike for someone may cost the firm considerable money.

Does the boss have all his relations on the job? Well, if so, it's too bad. Nothing will lower the morale of men more than this.

I suppose being a chief is no bed of roses. In many cases he is left holding the bag by the former chief, especially if he has young ideas and comes into a plant with old traditions and old men. But, by being a man, having high ideals and practicing the golden rule, he will eventually get there. Of course he has to be fearless and have what it takes. In many cases he even has to find out the hard way whether the job is worth it or not for the salary he gets and the hours he puts in per day.

JOSEPH BONCIORNO *Ottawa, Ontario*

Practical Idea That Isn't Practical

IN DEC 1950, *Operating Engineer*, "Practical Ideas," p 60, Cory Breslin talks about filling a 75-psi boiler by having a 30-gal hot-water tank installed 6 ft above boiler with suitable drain and equalizing connections.

I doubt very much if the state ordnance or local boiler inspector would allow such a connection even for a day because hot-water tanks are generally made of light-gage metal and are not suitable for 75-lb pressure.

I must criticize this article because it might give some smart alec of an en-

gineer an idea of doing same on a high-pressure boiler, since the pressure in tank and boiler must be equalized to get water in boiler. This is extremely dangerous, especially if it is an old tank and has never had a hydrostatic test. Regardless of whether this is a riveted or a welded job, this method should never be used.

Lower steam pressure below city-water pressure or have two injectors installed at all times. The work and material involved here would pay for two injectors and I am surprised that this idea was passed on to engineers who know better.

JOSEPH BONGIORNO *Ottawa, Ontario*

Here's Good Dope on Boiler Handling

MR SPAULDING asks when to lay up boilers, Feb *OE*, p 53. In his case this is really two questions because he states that there seems to be a lot of argument, both about economy and time of lay up.

Neither of these questions can be answered by anyone except Mr Spaulding. And he can do it only after study of all the variables.

However, I can try to advise him. And a good many things have to be considered in doing so, because what is good for his plant may not be the right thing for another and vice-versa.

He also wants to know which is right, running at normal boiler rating or at a higher percent of overload?

Taking this question from the standpoint of boiler plants in general, I'll ask him to consider these questions: (1) Is the company he works for forcing him to run at overload (due to seasonal or rush production)? (2) Is it caused by too much air, causing low CO_2? (3) Are his boilers too small for the load carried? (4) Are his boilers dirty, his baffles bad, brickwork bad, or a combination of all? (5) Is overload due to boilers being off line for repairs, making remaining boilers overwork to carry the load?

Assuming now that none of these conditions exist in Mr Spaulding's plant, but that he just believes that this is the best thing to do, we'll have to consider other questions: (1) Is running his boilers at high rating causing carry-over of solids that may hurt his turbines? (2) Is too much saturation or moisture carrying over that may hurt his engines and pumps by washing down his lubricant, causing scoring? (3) Is the economy he is getting more than offset by too high a CO_2 and heat release? In other words—if he saves $1.00 in fuel, is it costing him $1.10 for repairs?

Nobody can answer these questions as well as the man running the plant.

The best thing for Mr Spaulding to do is to study the special sections on Fuels & Combustion which were published in *POWER and OPERATING ENGINEER*. And get some good special-section reprints sold by *POWER* (McGraw-Hill); such as, *Fuels and Firing, Steam Generation, Combustion Control,* and *Power Handbook,* Parts 1 & 2. That's the only way he'll reach a solid conclusion that will help his particular plant.

In our plant we usually carry from 125 to 200 percent rating on our boilers with economical results. Here are the reasons: (1) We have modern water-wall boilers with little brickwork. (2) Our boilers are equipped with good cyclone separators which prevent most carryover. (3) The boilers are kept perfectly clean because we can't afford to take chances with gas fuel and this kind of load with burnouts due to scale. (4) They are kept under a rigid inspection and close chemical treatment.

Impingement from oil or gas flame, slag from stokers or hand firing, or wet walls from washing down soot are bad but ordinary starting up should not damage walls.

ED J DUFF *Aurora, Colo.*

WE'RE STILL SHOVELING

WHEN I LEARNED boiler firing, the man shown on the left, above, was the right-handed shoveler and the man on the right was left-handed.

W H MILLER *Lancaster, Pa.*

I AM RIGHT HANDED. And I've done my share of shoveling. If I have plenty of room I shovel like the man on the left.

However, if space is crowded and there are two boilers set up close together as in the picture, I would fire the two furnaces exactly the way they are shown. One man will have to do it the hard way.

H T LIVINGSTON *L. A., Calif.*

EDITOR'S NOTE: *The new* POWER *Handbook will not be available in reprint form until Part 2 is published in July.*

Boiler Figuring

GEORGE SPAULDING'S statement "I believe in working boilers for all they're worth", Feb *OE*, p 53, is all right if he takes some account of that word "worth". If he guesses much too high he may run into tube failures on overworked (or *overworthed*) boilers. And if he guesses only *somewhat* too much, he adds the loss of extra Btu going up the stack.

Most boilers, when steaming at designed rating, are working beyond the hump in the efficiency curve.

For illustration let's suppose Spaulding's six boilers give needed steam at 100 percent rating. (If one is laid up the others have to steam at 120 percent rating.) And he has 200,000-lb-per-hr 400-F boilers, feedwater inlet temp of 180 F; fuel costs 34¢ per million Btu.

Assuming boiler efficiency drops from 82 to 78 percent when using 5 boilers, fuel costs him about $25 more per hr. Multiply this by number of steaming hours and you get a big figure.

R H FREYBERG *Pleasantville, N. Y.*

EDITOR'S NOTE: *A four point drop in efficiency when output increases 20 percent is not likely in a 200,000 lb-per-hr boiler. Main reason for not pushing boilers is more maintenance.*

HOW TO WELD ALUMINUM PIPING

1 Tack aluminum fittings in place like this before starting to weld

Courtesy of Tube Turns, Inc, Louisville, Ky.

2 Lay first bead after removing dirt or grease with grease solvent. Remove aluminum oxides mechanically with steel wool or wire brush from welding bevels

3 Complete weld by laying on additional beads like this. Argon-gas-shielded tungsten-arc process shown works best

4 Finished job is perfectly welded joint. Remove flux left after welding or adjacent metal will corrode quickly

► ALUMINUM PIPING is welded with argon-gas-shielded tungsten-arc welding. You need an arc transformer-type welder, with a high-frequency stabilizing device and a water-cooled tungsten-arc argon-gas welding torch.

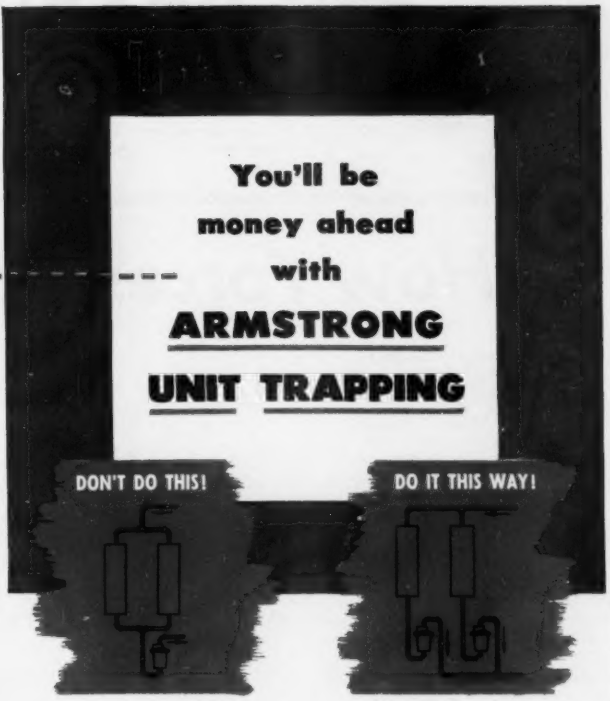
A cylinder of argon, cooling water and hoses and gas-flow rate indicator are main extra pieces needed. The torch utilizes one tungsten electrode and blankets the weld metal and adjacent pipe metal with argon gas. This keeps the oxides from forming. The operator has good control over the weld pool and can easily produce sound ductile welds.

Cleanliness is important in all aluminum welding. Remove dirt or grease with carbon tetrachloride or other grease solvent. With steel wool or wire brush remove aluminum oxides from welding bevels and surfaces inside and outside the pipe.

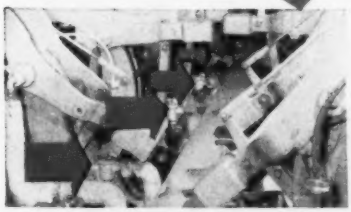
All commercial welding processes, gas and metallic and carbon arc, can be used in assembling aluminum and aluminum-alloy piping. But argon-gas-shielded tungsten-arc process has replaced other processes because it does not require flux and can be used to weld in all positions. Oxy-acetylene and oxy-hydrogen processes, using flux to break up the oxide coating and permit coalescence of the filler metal, are also used in welding pipe.

Thoroughly remove flux left after welding by scrubbing with hot water or by an acid rinse. Corrosion will set in adjacent to weld if flux is not removed, especially when welding aluminum.

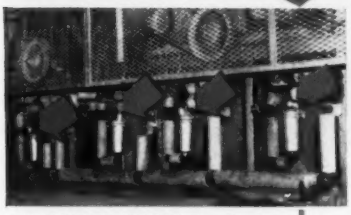
You'll be money ahead with ARMSTRONG UNIT TRAPPING



THE SAVINGS WILL PAY FOR THE EXTRA TRAPS!



SAVES 14 TONS COAL MONTHLY... that's the profitable result of changing over to Armstrong Traps . . . *M. Wile and Company, Buffalo, N. Y.*



2-3 HOURS FASTER HEAT-UP... starch drier takes new lease on life after Armstrong Unit Trapping... *Industrial Grain Products, Ltd., Fort Williams, Ontario*

40° TEMPERATURE RISE... pyrometer readings on flatwork ironer rolls prove performance of Armstrng Unit Trapping . . . *Peter Bent Brigham Hospital, Boston, Mass.*

IT IS false economy to drain more than one coil, kettle, unit heater or other steam-consuming unit with a single trap. In the first place a single trap for several units must be larger and higher priced than the individual trap on *each* unit, so the difference in original cost is not as great as it might first appear. But the difference in performance can be *tremendous.* The slightest difference in condensing rate between two units will cause a difference in steam pressures between the units. Even a few ounces pressure difference will hamper drainage of condensate and, most important, will prevent or retard flow of air from the lower pressure unit. The result is widely varying and subnormal temperatures, less heat output, slower heat-up, less production and higher operating costs.

Don't be penny wise and pound foolish. Install a trouble-free Armstrong trap on each steam-consuming unit in your plant. Call your Armstrong Representative today.

ARMSTRONG MACHINE WORKS
812 Maple Street • Three Rivers, Michigan

SEND FOR THE STEAM TRAP BOOK —

SEE OUR CATALOG IN SWEET'S or C.E.C.

36 pages of practical data on selection, installation and maintenance of traps. Yours for the asking.

ARMSTRONG STEAM TRAPS

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH

How Forces Balance–1

► THE ENGINEER who knows how to plot and balance forces can use this skill to solve a lot of practical problems. This page, plus a few to follow later, will tell how. And it's not hard.

First a word about *vectors* and vector addition. A vector is any quantity that has both an amount and a direction. Wind velocity is a vector. So is a force. It's easy to lay out a vector as an arrow. Arrow points in the direction of action. Its length shows the amount to any scale you may choose.

You can "add" vectors, but not in the way you add simple numbers, for the direction has to be considered. Suppose you walk 2 miles north, then 2 east and 2 south. What do you accomplish? You travel 2 miles east. You can plot this path by drawing 4 arrows in sequence, like this: up two, right two, down two. Then draw a dotted line from start of first to end of last. Line runs two miles right. Put an arrow tip on it and you have the result, or net effect of all the wanderings. It's called the *resultant*.

You add force vectors in exactly the same way. In Fig. 1, note how arrows *A*, *B*, *C*, and *D*, the forces acting on point *p*, are placed end to end with arrows all running the same sense, as in a one-way zig-zag street. The resultant, dotted line running from butt of first arrow to tip of last, is the single force that could replace the bunch to give the same effect.

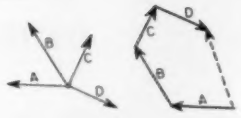
In "adding" the arrows note that they can be moved, *but must not be turned*.

When a body is at rest the forces at any point must add up to zero. Otherwise the body would start moving. That means that if you plot the forces acting at any joint of a bridge, derrick, framework or machine the force triangle of polygon must "close", tip of last arrow falling on butt of first.

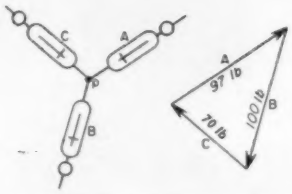
Note the triangles and polygons in Figs. 2, 3 and 4. All of them close. In each case you use the given data to draw the triangle or polygon to scale. Then you measure off unknown forces.

In all examples on this page the forces act through a single point.

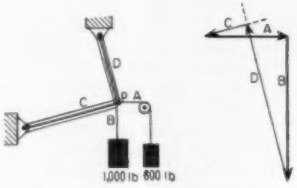
More practical examples next month.



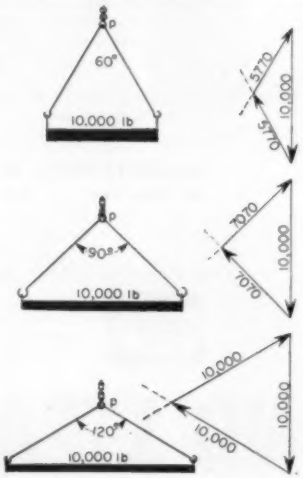
1 Add four forces by placing arrows end to end, all running the same way, as in a zig-zag one-way street. See text for other details, and meaning of *resultant*



2 The three pulls don't move the knot *P*, so we know they balance. That is they add up (by vector addition) to zero. Test this yourself with three balances.



3 Here four forces act on point *p*. Since *p* does not move the 4-sided figure made by "adding" *A*, *B*, *C* and *D* must "close." Enough data is given to draw the figure. First draw *A* and *B*. Then draw the known *directions* of *C* and *D*. Stop them where they cross. Then measure *C* and *D*. *C* measures 300 lb to *left* (tension). *D* measures 1150 lb *up* (tension).

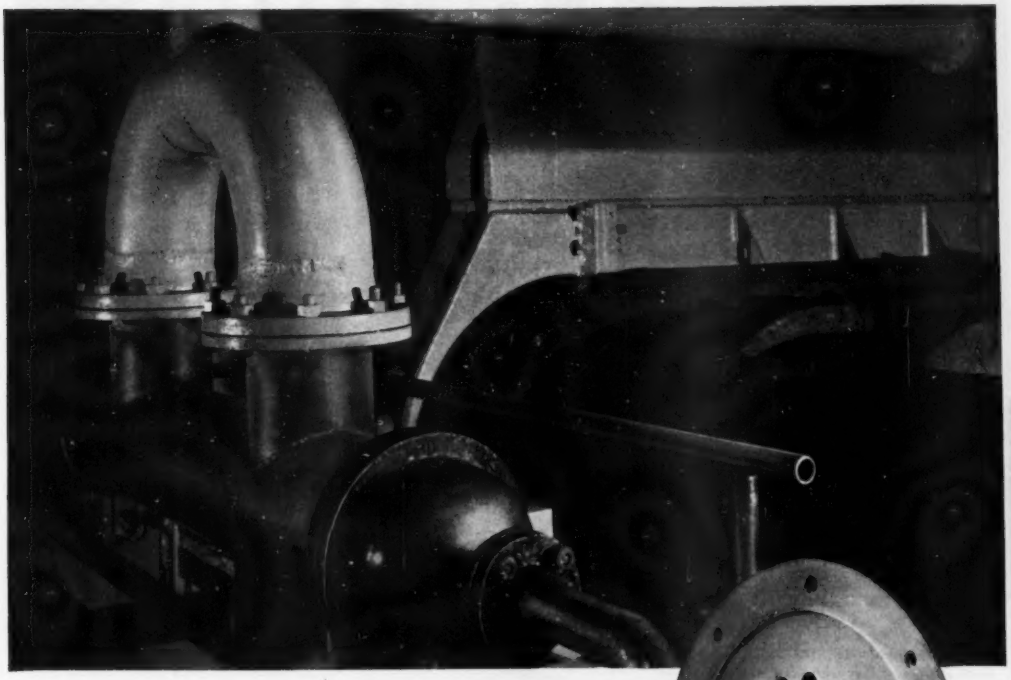


4 When legs of a wire-rope sling hang straight down they can do full duty. Spreading them at an angle cuts down the safe load they can carry.

The force triangles show why and how much. If you take the "straight-down" safe load as 100%, it is reduced to 87% for 60° angle, 71% for 90° angle and 50% for 120° angle.

Here's a handy rule to use on the job. Note how much the spread shortens the *vertical dimension* of the sling leg. Safe load is reduced in the same proportion. Say sling leg is 6 ft long, but swung out until it is only 4 ft high. Then safe load is reduced to 4/6 normal, or about 66%.

We **like** our tube customers skeptical



Test condenser operating in parallel with main turbine condenser at Narragansett Electric Co. Station in Providence, R. I.

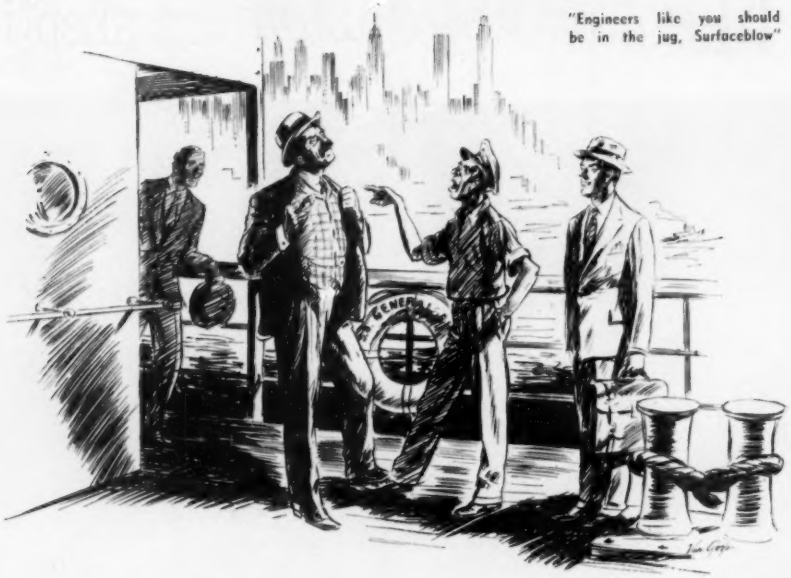
18 tubes are now undergoing performance tests under same cooling water and operating conditions as main unit.

Long ago we learned there's nothing like a good hard fact to convince a prospective customer for heat exchanger or condenser tubes.

The kind of facts our Technical Department likes to give our customers come out of tube performance studies like this 18-tube test condenser installed at the Manchester Street Station of The Narragansett Electric Co. at Providence, R. I. To attempt to reduce tube failure from pitting by polluted harbor water, this test unit was installed at the suggestion and with the help of Anaconda condenser tube specialists. It operates in parallel and under identical conditions with a main turbine condenser. Among tube alloys under test are Arsenical Admiralty 439, Ambraloy 927 (Aluminum Brass), Ambraloy 901 (Aluminum Bronze), Super-Nickel 702 and Cupro-Nickel 754.

We are sure that our Technical Department's extensive facts and long experience with the performance of ANACONDA Tubes under almost every type of operating condition can help you select the right heat exchanger or condenser tube. May we make them available to you? The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 51190

for efficient heat transfer **ANACONDA®** HEAT EXCHANGER TUBES



"Engineers like you should be in the jug, Surfaceblow"

$14,000—But No Soap

► IT WAS BALLASTING TIME at Bedlams Bent Propeller Bar when our new space salesman Wally Ponder and I dropped in yesterday. Marmaduke Surfaceblow held down his usual end of the bar opposite the brightly polished bent propeller.

Our engineer emeritus had his running lights fixed on a bottle of Sandpaper Gin before him, and seemed deep in thought. The old gray bowler atop his silvery dome had a sharp list to starboard. We could tell he was silently wrestling with problems of the universe.

We had no sooner barged through the crowd of waterfront characters to a corner table when all hell broke loose.

"BILGEWATER ON SLOPPY OPERATORS," roared Marmaduke. Then he quickly ballasted his deep tanks, slammed down his bottle and turned toward his audience.

What brought on this outburst? We'll never know. But everyone froze dead in his tracks. All eyes turned toward our unpredictable hero. Marmy fixed his thumbs in the armpits of his checkered vest and blasted away. There was nothing to do but listen.

"During this last war I was chief engineer on the army transport *General Sherman*. I had brought her out of the building yard two trips before. After working most of the bugs out of her plant they transferred me to another ship being built.

MARMADUKE SURFACEBLOW

"The *Sherman* was turned over to Andy Shotski, an old timer who did all his engineering on up-and-down jobs. But engineers were scarce and Shotski's license covered both reciprocating and turbine engines.

"Now one difference between reciprocating and turbine jobs is that an up-and-down engine can be patched up to bring the ship into port if any part fails. But you can't often do that with a turbine plant.

"If the turbine bearings fail because of oil, the rotor blades touch the stationary blades. With the machine running anywhere from 4,000 to 6,000 rpm, only thing to do is pray for a tow back to port.

"And if the steam end is damaged, so is the gear end. In that case, the ship is a salvage job. That means any ship towing you can collect as much as 75 percent of your cargoes' value. All this means that lube oil is the lifeblood of a turbine-reduction job.

"The Sherman held 4,000 gallons of inhibited oil in her system. And I always kept a sharp eye on that oil. Ever since turning her turbines over the first day, I took daily test-tube samples from her centrifuge and kept them in the log room. By watching those samples, I could see if water and impurities were settling out or if oil was sludging or soaping up.

(*Continued on page* 216)

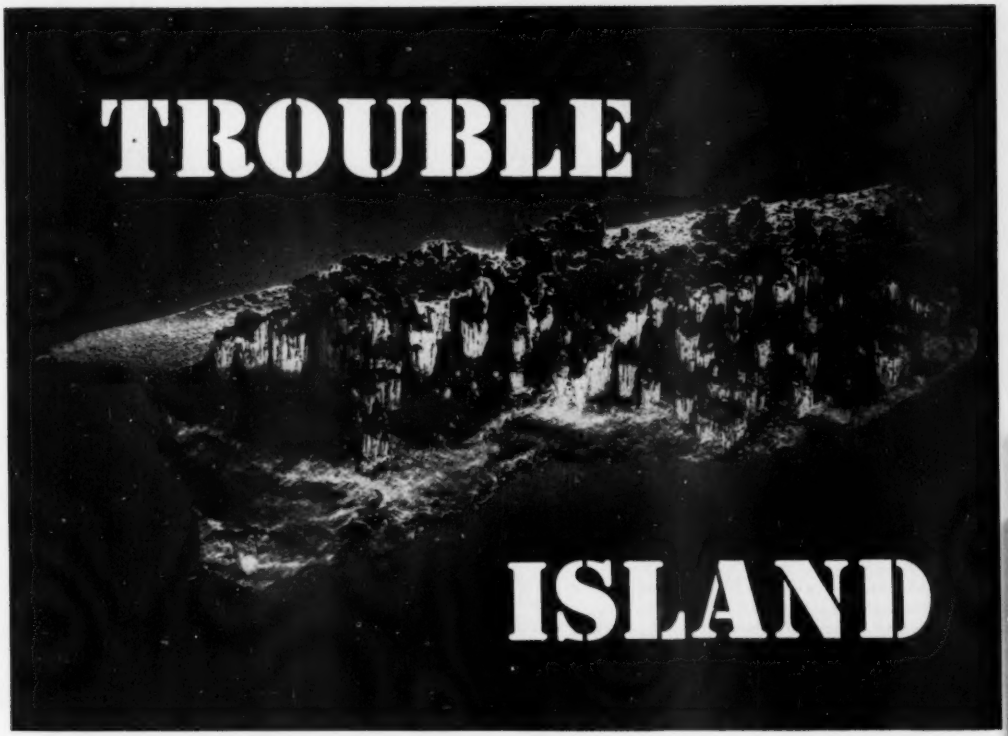


Photo is of a condenser-tube scale sample, about eight inches long. Solid scale is approximately ¼-inch thick, with "spires" ranging up to ⅜-inch height.

FIFTEEN years ago, this small island of trouble was part of a much larger open-box condenser problem at a refinery. Cooling water, running over 200°F. at outlet, contained 30 grains per gallon hardness and 20 parts per million iron. Tubes scaled heavily and rapidly without chemical inhibitor. Even with the best inhibitor then known, results were as illustrated above: partial inhibiting action creating the "spires" or forest-like deposits on tubes.

Considering this a challenge, Nalco sent a Doctor of Physical Chemistry — an expert water technologist — to the refinery. His weeks of work on the spot led to basically different treatment with new chemicals which cleaned up the condenser and kept it clean. Further Nalco research and development of chemical inhibitors has since enabled cooling systems to operate without scale or corrosion *with water hardnesses as high as 200 grains per gallon.*

Point is this: neither Nalco nor anyone else had an answer to scaling in that condenser. Nalco put the necessary brains to practical use and *got results* . . . benefiting, in the long run, not only that particular refinery, but every user of cooling water.

Whether your water treatment problem is unique, or stubborn plant-run, you will get prompt, decisive action from Nalco in the direction of positive results. Write or telephone today.

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THE *Nalco* SYSTEM . . . Serving Industry through Practical Applied Science

JENKINS PRACTICAL PIPING LAYOUTS

56

How to plan

AUTOMATIC COMBUSTION CONTROLS

On small boilers, automatic combustion control (1) maintains constant steam pressure regardless of steam demand, and (2) permits highest possible boiler efficiency by operating with correct air-fuel ratio. The system illustrated here is the hydraulic control type for a forced draft oil-burning boiler. It utilizes three controller units — fuel, fuel-air ratio, and furnace draft. A conventional differential pressure fuel oil piping system is shown for the oil burner supply.

Small changes in steam line pressure, resulting from fluctuations in steam demand, are transmitted to a primary controller. They actuate hydraulic control valve X, which in turn controls the flow of hydraulic fluid to a hydraulic cylinder. This cylinder adjusts the fuel control valve to the oil burners through a series of mechanical links. The fuel-air ratio controller is pre-set through the same fuel control valve linkage.

Furnace pressure from two tapped points in the flue-gas flow stream is transmitted to the fuel-air ratio controller which actuates hydraulic control valve Y. This valve positions a damper in the furnace air supply duct, regulating the flow of air into the furnace to maintain a correct fuel-air ratio.

A draft controller, operated by furnace pressure, is installed to maintain balanced furnace pressure. It also prevents the escape of flue gases into the boiler room, as well as excessive infiltration of air into the furnace. This balance is effected by hydraulic control valve Z and the power cylinder which operates the flue gas damper.

As shown in the insert, manual control of any or all three power cylinders can be accomplished by the installation of a four-way port lubricated plug valve hookup. Flow of hydraulic fluid to the cylinders can be controlled by closing the four gate valves and operating the four-way plug valve.

For the control of fuel oil pressure, where close regulation of flow is required, Jenkins Fig. 741-G Bronze Needle Globe Valves are recommended. These valves have a needle-pointed spindle of stainless steel.

This fits securely into its seat, assures drop-tight closure with least closing effort. Body of the Fig. 741-G is made of high tensile bronze, liberally proportioned and extra strong. One-piece bonnet screws into body. Packing box is liberal in depth, and packing is high pressure asbestos material, lubricated and graphited for long service.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the Jenkins Catalog. It's your best assurance of lowest cost in the long run. Despite their extra value, *you pay no more* for Jenkins Valves. Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal. Sold through leading Industrial Distributors everywhere.

NEW BOOK OF PIPING LAYOUTS — NOS. 26 to 50

A new book of Jenkins Practical Piping Layouts — Nos. 26 to 50 — is now available. Mail coupon to get your copy.

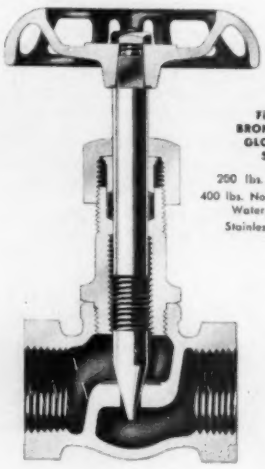

Fig. 741-G
BRONZE NEEDLE GLOBE VALVE
Screwed

200 lbs. Steam Pressure
400 lbs. Non-Shock Cold Oil, Water, Gas Pressure
Stainless Steel Spindle

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B Place valves correctly in the line

C Choose Jenkins for lifetime economy

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LOOK FOR THE DIAMOND MARK

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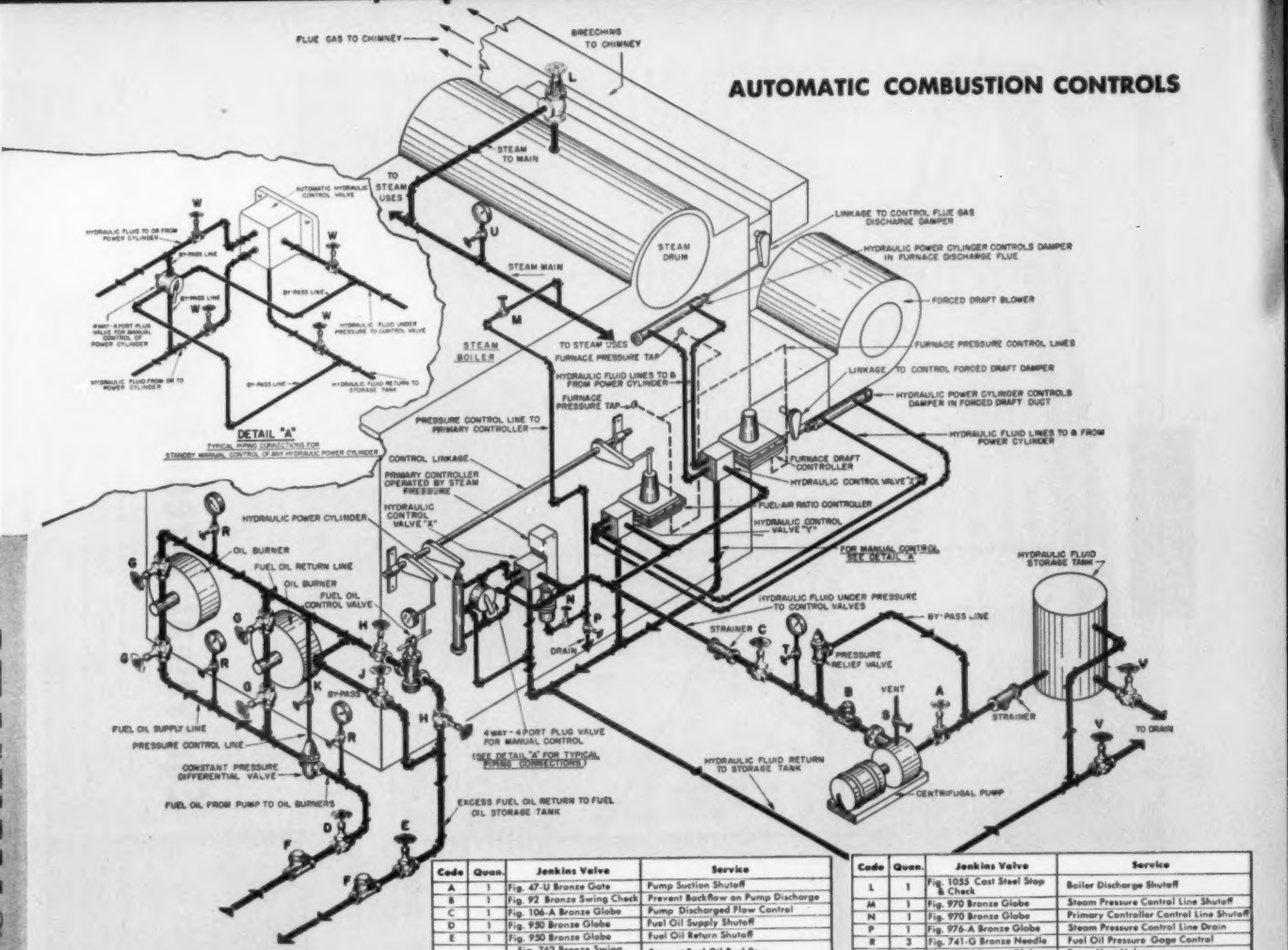
AUTOMATIC COMBUSTION CONTROLS


FLUE GAS TO CHIMNEY
BREECHING TO CHIMNEY
STEAM TO MAIN
TO STEAM USES
STEAM DRUM
STEAM MAIN
STEAM BOILER
LINKAGE TO CONTROL FLUE GAS DISCHARGE DAMPER
HYDRAULIC POWER CYLINDER CONTROLS DAMPER IN FURNACE DISCHARGE FLUE
FORCED DRAFT BLOWER
FURNACE PRESSURE CONTROL LINES
LINKAGE TO CONTROL FORCED DRAFT DAMPER
HYDRAULIC POWER CYLINDER CONTROLS DAMPER IN FORCED DRAFT DUCT
HYDRAULIC FLUID LINES TO & FROM POWER CYLINDER
FURNACE DRAFT CONTROLLER
HYDRAULIC CONTROL VALVE "Z"
FUEL-AIR RATIO CONTROLLER
HYDRAULIC CONTROL VALVE "Y"
FOR MANUAL CONTROL SEE DETAIL "A"
HYDRAULIC FLUID STORAGE TANK
HYDRAULIC FLUID UNDER PRESSURE TO CONTROL VALVES
BY-PASS LINE
STRAINER
PRESSURE RELIEF VALVE
VENT
TO DRAIN
CENTRIFUGAL PUMP
HYDRAULIC FLUID RETURN TO STORAGE TANK
EXCESS FUEL OIL RETURN TO FUEL OIL STORAGE TANK
4 WAY - 4 PORT PLUG VALVE FOR MANUAL CONTROL
(SEE DETAIL "A" FOR TYPICAL PIPING CONNECTIONS)
DRAIN
FURNACE PRESSURE TAP
HYDRAULIC FLUID LINES TO & FROM POWER CYLINDER
PRESSURE CONTROL LINE TO PRIMARY CONTROLLER
CONTROL LINKAGE
PRIMARY CONTROLLER OPERATED BY STEAM PRESSURE
HYDRAULIC CONTROL VALVE "X"
HYDRAULIC POWER CYLINDER
OIL BURNER
FUEL OIL RETURN LINE
OIL BURNER
FUEL OIL CONTROL VALVE
BY-PASS
FUEL OIL SUPPLY LINE
PRESSURE CONTROL LINE
CONSTANT PRESSURE DIFFERENTIAL VALVE
FUEL OIL FROM PUMP TO OIL BURNERS
DETAIL "A"
TYPICAL PIPING CONNECTIONS FOR STANDBY MANUAL CONTROL OF ANY HYDRAULIC POWER CYLINDER
AUTOMATIC HYDRAULIC CONTROL VALVE
HYDRAULIC FLUID TO OR FROM POWER CYLINDER
BY-PASS LINE
4 WAY - 4 PORT PLUG VALVE FOR MANUAL CONTROL OF POWER CYLINDER
HYDRAULIC FLUID FROM OR TO POWER CYLINDER
HYDRAULIC FLUID UNDER PRESSURE TO CONTROL VALVE
HYDRAULIC FLUID RETURN TO STORAGE TANK

VALVE RECOMMENDATIONS

For details of valves to suit varying conditions, see Jenkins Catalog.

Code	Quan.	Jenkins Valve	Service
A	1	Fig. 47-U Bronze Gate	Pump Suction Shutoff
B	1	Fig. 92 Bronze Swing Check	Prevent Backflow on Pump Discharge
C	1	Fig. 106-A Bronze Globe	Pump Discharged Flow Control
D	1	Fig. 950 Bronze Globe	Fuel Oil Supply Shutoff
E	1	Fig. 950 Bronze Globe	Fuel Oil Return Shutoff
F	2	Fig. 762 Bronze Swing Check	Prevent Fuel Oil Backflow
G	4	Fig. 950 Bronze Globe	Burner Shutoffs
H	2	Fig. 270-U Bronze Gate	Fuel Oil Control Valve Shutoff
J	1	Fig. 956 Bronze Globe	Manual Fuel Oil Control
K	1	Fig. 741-G Bronze Needle	Fuel Oil Pressure Control Line

Code	Quan.	Jenkins Valve	Service
L	1	Fig. 1055 Cast Steel Stop & Check	Boiler Discharge Shutoff
M	1	Fig. 970 Bronze Globe	Steam Pressure Control Line Shutoff
N	1	Fig. 970 Bronze Globe	Primary Controller Control Line Shutoff
P	1	Fig. 976-A Bronze Globe	Steam Pressure Control Line Drain
R	3	Fig. 741-G Bronze Needle	Fuel Oil Pressure Gage Control
S	1	Fig. 106-A Bronze Globe	Pump Vent Valve
T	1	Fig. 741-G Bronze Needle	Pressure Gage Control
U	1	Fig. 703 Bronze Needle	Pressure Gage Control
V	2	Fig. 106-A Bronze Globe	Hydraulic Fluid Drains
W	4	Fig. 47-U Bronze Gate	Automatic Control Shutoff

Diagram by Huxley Madeheim
Consulting Engineer

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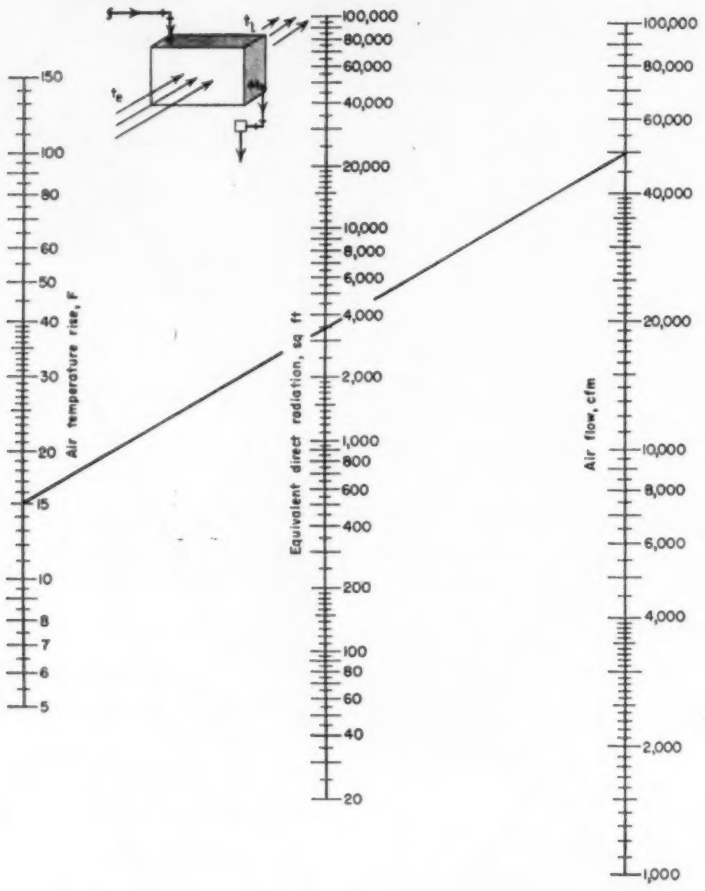
Jenkins Bros

Number 226



Equivalent Direct Radiation

► HEATING-SYSTEM DESIGN and performance are expressed in terms of square feet of equivalent direct radiation. This term ties directly to the air flow over the heater surface and the air-temperature rise in passing through the heater. The relation is:

$$EDR = Q(t_1 - t_2)/220.8$$

where

EDR = equivalent direct radiation, sq ft
Q = air flow, cfm
t_1 = leaving air temperature, F
t_2 = entering air temperature, F

The nomogram enables quickly solving this formula for any of the three major terms.

Example: Let's find the *EDR* of a heating unit when 50,000 cfm of air passes through. The air enters at 65 F and leaves at 80 F.

We can quickly figure 80 – 65 = 15 F. Locate 15 F on the left-hand scale. Next, find 50,000 cfm on the right-hand scale. Connect these two points with a straightedge and find 3400 sq ft at the intersection with the middle scale.

T G HICKS, *Assistant Editor*

. . . WANT TO IMPROVE YOUR POWER PLANT OPERATION

. . . AND CUT YOUR COSTS AT THE SAME TIME ?

Tile Silo & Elevator

Today's story of climbing costs and narrowing profit margins in your power plant operation can only be changed by top efficiency in your operating equipment. Obsolete or badly worn units may be costing you many times their original worth and serve as hidden costs in overhead. Today, more than ever before, it pays to survey your operating equipment . . . and when it comes to your power plant, a trained Fairfield Engineer will do it for you. His recommendations are based upon saving you money and economically improving the efficiency of your plant. Write or call for him today.

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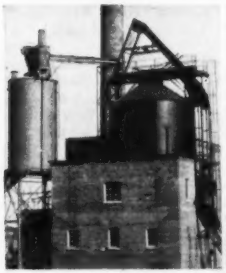
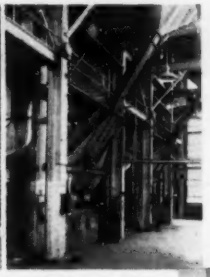


Skip Hoist & Cylindical Bunker

Tile Ash Bunker & Elevator



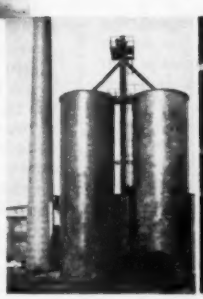
Above-Chutes to Stokers from overhead bunker, with non-segregating distributors

At right—Weigh Larry serving three boilers

Below—Belt Conveyor in tunnel

At right—Large capacity Twin Silo system

At far right—Screw Conveyor feeding stokers



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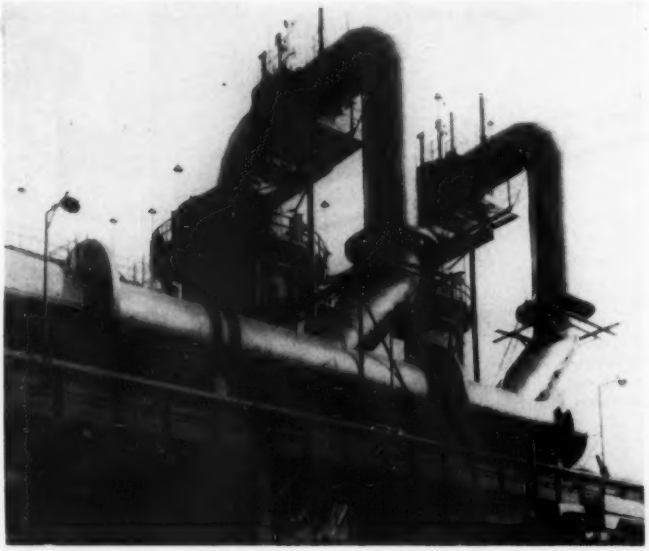


SMOKE CONTROL of steam generators, fired by blast-furnace gas, takes place before gas ever gets to the furnace. National Tube Co, McKeesport, Pa., puts gas washers and then electrostatic precipitators in the path of the incoming gas before firing

COMING EVENTS

April 2-6—Oil Heat Institute of America, 28th annual convention, Palmer House, Chicago, Ill. Mr. Kaufman, secy, OHI, 6 E 39 St, New York.

April 4-6—Midwest Power Conference, annual meeting, Sherman Hotel, Chicago, Ill. R A Budenholzer, director, Illinois Institute of Technology, Chicago 16, Ill.

April 16-18—American Society of Lubricating Engineers. Annual meeting, Bellevue-Stratford Hotel, Philadelphia, Pa. W F Leonard, secy, ASLE, 343 S Dearborn St, Chicago, Ill.

May 4—Anthracite Institute, Ninth annual Anthracite Conference, Lehigh University, Bethlehem, Pa. A C Callen, general chairman, Lehigh University.

May 6-10 — Air Pollution and Smoke Prevention Assn of America, 44th annual meeting. Hotel Roanoke, Roanoke, Va. C S Frost, chairman.

May 7-11—Greater New York Industrial Show, Technical Societies Council of New York, Inc, Armory, 34th St and Park Ave, New York. Orkin Management, 8 W 40th St, NYC.

Another Gas-Turbine Station for New England

Central Vermont Public Service Corp is erecting the first section of a new gas-turbine plant at Rutland that will ultimately house four units. First two go into operation about July 1951 and January 1952. These units, nominally rated at 5000 kw each by the manufacturer, will have capabilities of 6000 kw at ambient summer temperature. These are of General Electric standard high-efficiency design using regenerators and intercoolers. A third unit, now under consideration, is expected to be similar, but will run at higher efficiency with regenerators having about 10% greater effectiveness.

The gas turbines are expected to run primarily on base-load schedule in parallel with hydro.

U. S. Controls Power Equipment

► A PLANNED PRODUCTION PROGRAM for heavy power equipment went into effect March 16 under the control of the National Production Authority, U.S. Dept of Commerce.

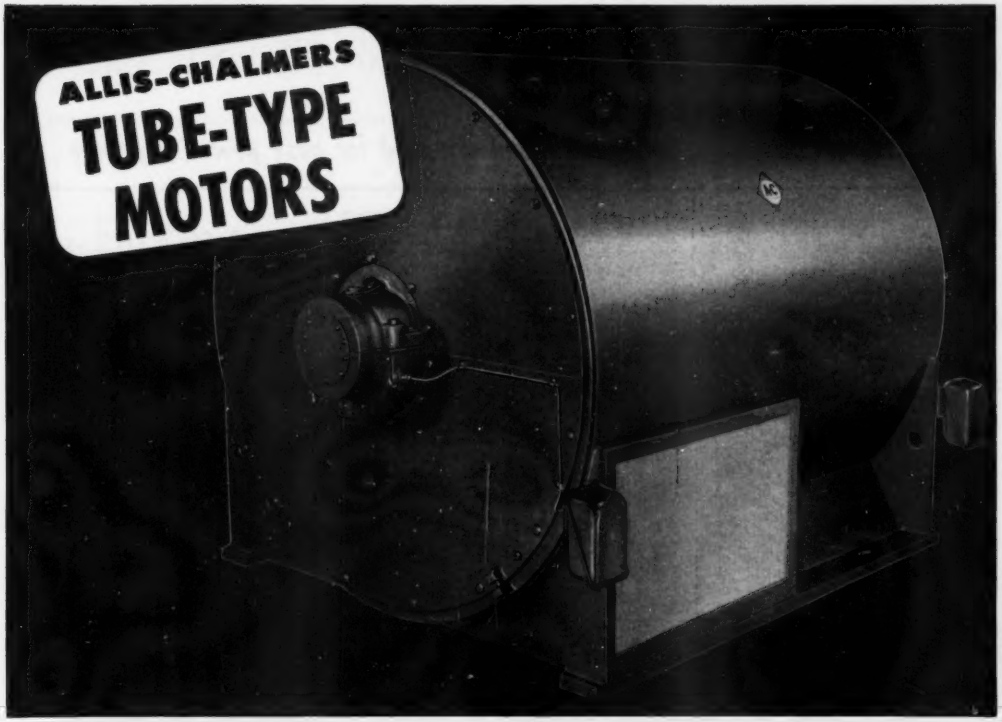
The order, identified as NPA Order M-44, requires manufacturers of heavy power equipment, defined below, to file monthly reports showing (1) orders on hand for such equipment (2) related production and delivery schedules. In addition, the manufacturer must "maintain, modify or alter production and delivery schedules as the NPA may at any time and from time to time direct." Further, the NPA may assist manufacturers by allocating steel, copper and aluminum as required to maintain production.

The purpose behind M-44 is to insure satisfaction of all defense requirements of the United States, both direct and indirect. Any changes of orders or allocation of materials is to be made at the discretion of NPA.

Equipment Covered. The following items are specifically designated provided they cost $5000 or more (equipment below $5000 is exempt):

Steam turbines, direct-connected or geared and steam-propelled turbine-generator sets, except for aircraft or locomotive use; hydraulic and hydro-electric turbines and water wheels and hydraulic turbine-driven generator sets; all diesel, dual-fuel, spark-ignition gas engines for mechanical drive or as generator sets operating at 750-rpm or less; steam boilers designed for above 100 psig, with a heating surface of 500 sq ft or more, exclusive of those for locomotives, including superheaters, reheaters, desuperheaters, waterwalls, oil burners, gas burners, pulverized coal burners, economizers, air preheaters,

(*Continued on page* 200)



Self-Cleaning Motor

Keeps Maintenance Costs Down

MOTOR CLEANING ROUTINE AND COST ARE PRACTICALLY ELIMINATED by the Allis-Chalmers tube-type, totally-enclosed, fan-cooled motor. Even when installed outdoors in contaminated atmosphere, dirt and corrosion cannot harm it.

The reason for this outstanding performance is the unique tube-type cooling system. Cooling air circulates through a nest of tubes which surrounds the stator, removing heat from the interior of the motor. The generous flow of air through the straight tubes carries dirt out to the atmosphere. There are no corners or pockets, as in conventional designs, which might collect large dirt deposits. If the tubes ever should need cleaning, a brush on a long handle will do the job in a few minutes.

Sizes range from 75 hp up. Tubes and end plates may be made of special corrosion resistant materials where necessary.

To-day, when manpower is high-priced and getting scarce, cutting maintenance time and cost is more important than ever. Ask your Allis-Chalmers representative to show you how this exceptional motor can reduce your maintenance requirements. Or write to Allis-Chalmers, Milwaukee 1, Wisconsin.
Ask for Bulletin 05B7150. A-3322

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Engineering developments here and abroad digested for busy power engineers

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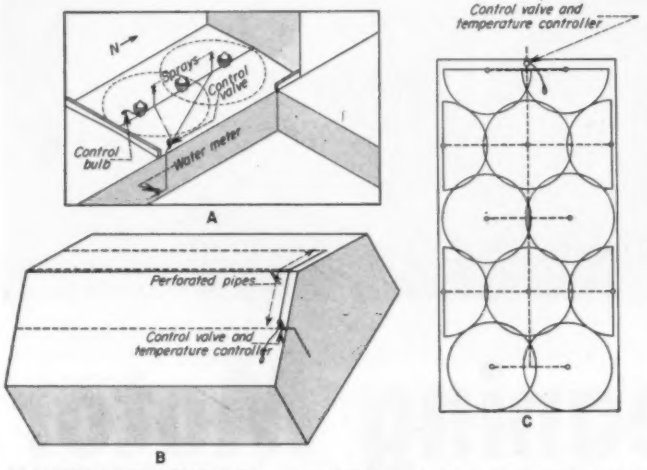
MAINTENANCE: The Maintenance of Power Plants and Heating Equipment • Maintenance in the Power Plant • Heating-Plant Equipment Maintenance

HEATING: Principles of Effective Heat for Steam-Heated Structures • Transportation Heating and Air Conditioning

AIR POLLUTION: Electrostatic Precipitation • Smoke Measurement in Fuel Oil • Rating of Fuel Oils • Smoke Measurement

HEAT PUMP: Theory of Earth Heat Exchangers for Heat Pump

Directions for ordering papers are given on page 156



ROOF-SPRAY ARRANGEMENTS for various buildings. *A*: Roof of building where test was conducted. *B*: Spray system for a pitched roof. *C*: Half- and full-circle sprays

Heat Transfer

ROOF SPRAY FOR REDUCTION IN TRANSMITTED SOLAR RADIATION, *by G E Sutton, Engineering and Industrial Experiment Station, University of Florida.* Effectiveness of roof sprays as a means of limiting surface temperatures of roofs exposed to solar radiation is shown. Paper details results of experiments in which adjustable 2-nozzle rotating-type roof sprays were operated under control of temperature bulb placed 5/8 in. below the roof surface.

Tests proved that the surface temperature of a roof that would reach 150 F under maximum solar intensity if unsprayed could readily be maintained at 100 F when sprayed. By comparison, 2-in. and 6-in. pools of water on the roof would maintain surface temperatures of 108 and 103 F, respectively.

As an aid to figuring loads, an equation for instantaneous heat flow through roofs is developed. Advantages of spray systems are given and recommendations made for suitable equipment. *ASHVE paper. No number.*

DESIGN FACTORS IN PANEL- AND AIR-COOLING SYSTEMS, *by Charles S Leopold, consulting engineer.* This paper gives details of engineering panel-cooling systems and discusses suspended ceilings consisting, in part, of cooling panels. Test data, applicable to suspended ceilings incorporating cooling panels, are given. A hydraulic analogue is used in analyzing performance of conventional air-cooling and panel-cooling systems. Temperature variations within a zone are cited. *ASHVE paper. No number.*

OPERATING EXPERIENCE AND DATA FROM A SIDEWALK SNOW-MELTING SYSTEM, *by L A Stevens and G D Winans, Detroit Edison Co.* A sidewalk snow-melting system, installed on two sides of a modern restaurant building in the business district of Detroit, and supplied with steam purchased from a local district heating company, provided valuable operating data reported in this paper. System and its operation are described and data given for both steam and electrical consumption.

Results based on this installation show there is no need to provide drainage for the melted snow. Solution heaters should be capable of condensing 0.4 to 0.5 lb of steam per hr per sq ft of sidewalk surface. Steam and electric consumptions are reasonable. It is desirable to operate snow-melting systems only when there is snow on the walk or when snow is falling. There is a need for a simple control to start system operation when snow begins and to turn it off when snowfall ends and sidewalks are free of snow. Snow-melting systems insure cleanliness in entrances and lobbies during snowfalls and reduce accidents. *ASHVE paper. No number.*

Maintenance

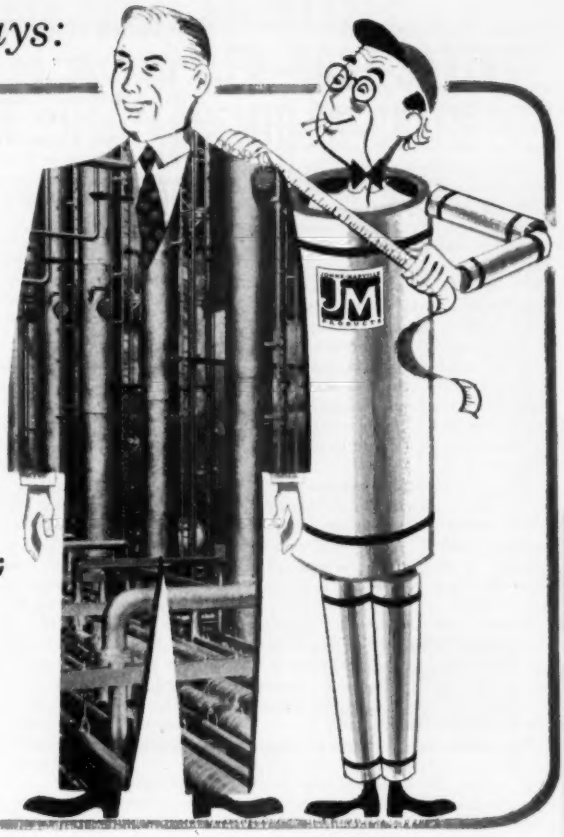
MAINTENANCE OF POWER PLANTS AND HEATING EQUIPMENT, *by F L Bradley, plant engineer, Forstmann Woolen Co.* Maintenance and its part in operating and managing a corporation have risen to major magnitude during the last two decades. Preventive maintenance, at least in its primitive form, made its appearance in the early power plants. Water treatment, to prevent hard scale deposits and caustic embrittlement in boilers, was one of the first steps to avoid boiler shutdowns and even explosions.

The insurance inspector's detailed check on governor valves and flywheels of steam engines prevented the runaway engine with its disastrous results. Reliability checks of overspeed governors and the periodic lifting of steam-turbine casings were recognized musts in the older power plant. Today we may classi-

Mr. Insulation says:

"Buying insulation is like buying a suit of clothes:

—the better the materials; the more expert the tailoring, the better your investment"



Just as no one cloth can be used for every suit of clothes, there is no one raw material that can serve as the ideal insulator for every industrial insulation job.

For this reason, Johns-Manville manufactures a wide variety of industrial insulations—of asbestos and other raw materials—each of which is designed for a special purpose. These insulations span the entire range of temperatures from 400 F below zero to 3000 F above.

But, again, there is much more to the story of insulations than their manufacture. In order to get the greatest return from your investment in them, they must be expertly engineered to the job, and then skillfully applied.

Johns-Manville makes available to you the service of experienced insulation engineers, and highly skilled mechanics for the proper application of Johns-Manville insulations.

If you are contemplating an insulation installation for your plant, it will pay you to look into this Johns-Manville insulation service. For further information just write Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville *first in* **INSULATIONS**

fy them under the category of preventive maintenance.

One of the most positive and profitable approaches to preventive maintenance is through proper design. Operation of a plant or its equipment, when that has been poorly designed, is always an uphill maintenance fight. The author then goes on to describe certain special power-plant apparatus that has been improved in operation and maintenance by better design and better material. *PMC paper. No number.*

MAINTENANCE IN THE POWER PLANT, *by O F Campbell, Sinclair Refining Co.* As plant production and processing grows, it is not necessarily accompanied by a growth in the power facilities. This equipment then becomes limited in capacity and any outages scheduled or unscheduled must be held to the lowest possible.

The author describes a very interesting procedure common to his company plants wherever they are found. This practice is called "turnaround" maintenance. It is planned on the basis of a major shutdown for each unit at least once a year.

Preceding this shutdown an elaborate preliminary planning program gets under way. It embraces everything from special tools and rigs to proper personnel and supplies for a thorough maintenance overhaul.

This maintenance overhaul is carried out like an army invasion. All equipment stands in readiness, the labor force has been alerted, and each maintenance step proceeds according to plans. A rather elaborate communication system has been set up to permit on-the-spot decision of unexpected problems. *PMC paper. No number.*

HEATING-PLANT EQUIPMENT MAINTENANCE, *by R S Hanson, General Motors Corp.* Preventive maintenance systems usually include some variation of the following procedures: (1) Detailed instructions to personnel for care of equipment. (These instructions can be in manual form and developed from manufacturers' data.) (2) Record of service for each major piece or type of equipment kept on suitable forms (3) Periodic analysis of these service records to determine where changes should be made.

The author describes certain typical boiler-room equipment, the important phase that design plays in good maintenance, the progress that development has brought about in both materials and operating methods as it bears on maintenance, and, last, the value of instruments and meters in both operation and schedule maintenance. *PMC paper. No number.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from one of the following sources:

Plant Maintenance Conference, annual meeting, Cleveland, Ohio, Jan 15-17, 1951. Papers are identified by initials PMC. Printed in bound form as Proceedings. Available through Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.

American Society of Heating and Ventilating Engineers, annual meeting, Philadelphia, Pa. Papers are identified by initials ASHVE. Obtainable from ASHVE, 1302 Swetland Bldg, Cleveland 15, Ohio.

Heating

PRINCIPLES OF EFFECTIVE HEAT FOR STEAM-HEATED STRUCTURES, *by C O Mackey, N R Gay, Cornell University; R D Tutt, Tuttle & Bailey, Inc; E G Powell, C A Dunham Co; and E L Broderick, consulting engineer.* Discusses the term *effective heat* and the means of giving it a definition. Object of the test was to determine condensate necessary to heat a given structure to a given condition with heating units having different air-ejection heights and air-outlet locations. It was further aimed at determining a new standard against which one could compare conductor performance.

The results of the test of a large number of heating units are given. The authors present a proposed table for effective heat allowance to be applied to convectors.

For each unit tested there was one point of temperature measurement in the room corresponding to the least condensation from the heater while maintaining the desired temperature at this point. This point was found to rise with height of heater or heater air outlet and varied somewhat in position, depending on heater construction.

From test results it was concluded that for the same outdoor temperature and infiltration and the same structure the room heat loss (based on average temperature at all levels in the center of the room) may vary with different heaters while maintaining the same average temperature. *ASHVE paper. No number.*

TRANSPORTATION HEATING AND AIR-CONDITIONING SYSTEMS AND CONTROLS, *by N O Kirkby, Vapor Heating Corp.* The steam locomotive is an almost inexhaustible source of heat limited only by pressure and size of steam-distribution line to the passenger cars. While a large amount of heat is present on the diesel, it is wasted to atmosphere through radiators and exhaust manifolds because there is no practical way of harnessing this heat within the limitations of size and weight restrictions.

Car heating of diesel and electric locomotives is now carried out by steam. But it requires a rather special steam generator. These steam generators are continuous coil-type units down-fired with the same diesel fuel as used on the power engine. They range in size from 500 to 4800 lb of steam per hr at different pressures, 75 to 300 psi. Steam quality is high, about 99.8%. Heat release within the furnace is about 1,000,000 Btu per cu ft of combustion space, almost 20 times usual stationary-power-plant practice.

Nowhere in industry do heating and air-conditioning engineers have more difficult problems to solve and more precise control specifications to meet, according to the author. On air conditioning, for example, he cites the fact that the average train load has increased from 5-6 tons to 7-8 tons per car. Better lighting, and more of it, has been used. Radios, record players and intercommunication systems have still further increased the electrical load. Diners are built with entirely electrical kitchens. *ASHVE paper. No number.*

Air Pollution

SURVEY OF ELECTROSTATIC PRECIPITATION, *by E A Walker and J E Coolidge, Pennsylvania State College.* Electrostatic precipitation today ranges from the very small household ventilation unit to the giant-size flyash installation, handling 200,000 cfm and precipitating some 200 tons of ash per day for the large public utility power plants.

The authors go into a description of the working of the electrostatic precipitator, the theories behind it, the transport problem, and the problem of discharging dust.

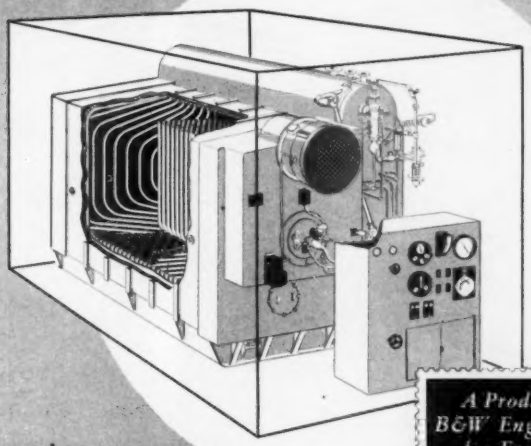
They spend considerable time discussing the unsolved problems, particularly those of electrical re-entrainment. They call attention to the fact that the statement is often made that electrostatic precipitators do a better job removing small particles than large ones. Theoretical considerations of particle charging and transportation indicate the opposite is true. There are several interesting illustrations of precipitated collection against precipitator length, current against relative humidity, efficiency against relative humidity, and the characteristic of parallel plate precipitation. *ASHVE paper. No number.*

(*Continued on page* 170)

NOW

Big boiler advantages "wrapped up" in NEW COST-SAVING B&W SHOP ASSEMBLED UNITS

B&W Integral-Furnace Boiler, TYPE FM



A Product of B&W Engineering for Economy

Cost-Saving Features of the New B&W Integral-Furnace Boiler, TYPE FM

- Saves Erection Time and Cost
- Meets Wide Range of Services
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

Here at last is the ideal combination for efficient, low-cost "packaged" steam: the new B&W Integral-Furnace Boiler, Type FM. It combines the many advantages of factory-assembled boilers with the service-proved economies of B&W Integral-Furnace construction. It's delivered fully-equipped for immediate operation.

Of prime importance is the fact that this new B&W boiler embodies design, construction, and operating features that have made larger capacity Integral-Furnace units such a heavy favorite among industrial plants and central stations.

Small and medium size plants, institutions, and commercial establishments will find this new unit the ultimate in low-cost heating and process steam-generation from 3,500 to 25,000 lb. per hr. at pressures to 250 psi. Large plants, too, where space and load characteristics warrant, may profitably consider several packaged boilers instead of a single "tailor-made" installation.

Engineered, designed and built under a single responsibility, the new Integral-Furnace Boiler, Type FM is backed by the same tradition of service satisfaction that has made B&W a by-word in low-cost steam generation for more than 80 years.

Helping Industry Cut Steam Costs Since 1867

BABCOCK & WILCOX

Send for Bulletin G-72, detailing the many advantages of this new B&W creation in low-cost steam generation.

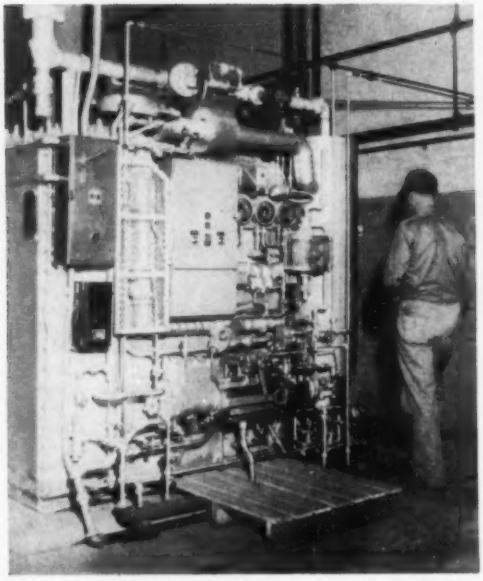
The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

G-506

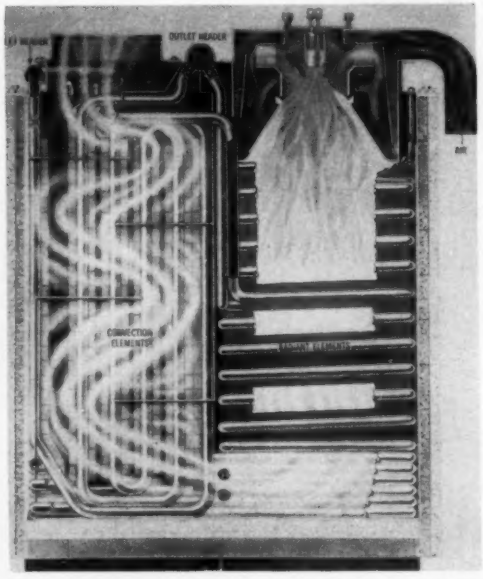
PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



1 Close space requirements, 6 ft 11 in. long, 5 ft 5 in. wide, 6 ft 11 in. high, *shown above*, for a 6000-lb-per-hr unit



2 Heat-transfer surface arrangement, *left of unit*, produces 3 to 4 times the steam per cu ft of conventional design

Compact, Quick-Steaming Boiler Uses Forced Circulation

P400 • Controlled recirculation of boiler water makes possible a heat-transfer rate in the oil- or gas-fired C-E Re-circulation Steam Generator that produces three to four times as much steam per cu ft of space as a conventional watertube or packaged fire-tube boiler of its capacity range. This high transfer rate, in turn, gives a quick-steaming, compact unit, Fig 1, that requires a space only 6 ft 11 in. long, by 5 ft 5 in. wide, by 6 ft 11 in. high for a 6000-lb-per-hr capacity at pressures up to 300 psi.

This unit was originally designed for diesel-engine train-heating service. Its features of quick-steaming high-pressure output make it applicable for industrial plants needing a relatively small or intermittent steam supply at moderately high pressures. It is also suited for remote areas where pipe installation and maintenance costs from a central steam source are too high.

The generator consists of the heating elements, Fig. 2, a feed-water pump, feedwater regulator, circulating pump, burner, fuel-oil pump, air blower and a driving motor. Water to the inlet header supplying the watertubes passes through individual metering orifices that assure a proper circulating head in all elements. Outgoing steam leaves the outlet header to enter a vertical drum, *right*, Fig. 1, known as the steam separator. Here the steam and any moisture entrainment are separated; the steam going to the outside steam line and water to suction side of pump.

Rate of water flow through the tubes is rapid enough to prevent any scale buildup. Whatever solids are carried in the water have a chance to drop out of solution at the separating drum. Here they fall to the bottom of this drum to what amounts to a sludge tank for blowdown out of the system.

Combustion Engineering-Superheater, Inc., 200 Madison Ave, New York 16, N. Y.

MECHANICAL PACKING **P408**

Highly resistant chemical packing for tough and demanding conditions, such as you meet in sulfurous, chromic, nitric, and in fact all acids, caustics or alkalies, results from a packing material called *Blu-Lon* made of 100% pure tape African blue asbestos entirely free of spinning-cotton content. This asbestos is immunized by Teflon *Suspensoid*.

A W Chesterton Co, Everett 49, Mass.

Sure They're Short . . .

. . . but we can't spare the space here to tell the whole story. There's more to the new equipment items than the few words we publish. So the smart thing for you to do is tear out one of the handy reply cards on page 166a. Then jot down the numbers of the items on these pages that you want to know more about. You'll find the numbers, preceded by a *P*, at the head of each item.—*Editors*

PIPE FITTING **P428**

Plastic-threaded connector element permits joining a plastic pipe to another metal pipe or fitting. A special adhesive, in this case Partrey, is applied to the plastic connector. The connector is then screwed into the metal piece.

C I A Associated Agencies, 484 Victoria Parade, East Melbourne, Victoria, Australia.

(Continued on page 160)

piping upkeep *costs more* now!

You spend less for it by using Dependable Quality

CRANE VALVES

. . . That's why more Crane Valves are used than any other make

Pressure-Seal Bonnet Gate—available in 600, 900, and 1500 pound classes

NO BONNET JOINT LEAKAGE . . .
NO BONNET JOINT MAINTENANCE

Big maintenance savings can be made on high-pressure/high-temperature piping services by using Crane Pressure-Seal Bonnet valves in place of bolted bonnet valves. Once installed, these valves rarely need maintenance of the bonnet joint—line pressure keeps it leak-tight.

Lighter weight and more compact dimensions make savings in piping erection and suspension. Streamlined body design reduces insulating costs.

Other outstanding and typical features of Crane Pressure-Seal Bonnet Joint design are tailored-to-the-service alloy steels, Stellite trim, deep stuffing box, and flexible wedge disc in larger gates. In gates, globes, angles, or stop-checks, these valves are an investment in better piping performance at lower ultimate cost.

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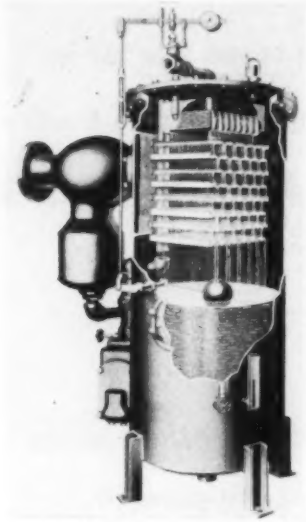
EQUIPMENT NEWS *CONTINUED*

HYDRO-PNEUMATIC PUMP P422

Normally powered by plant air this pump is self-contained and develops pressures up to 20,000 psi at small volume. It is used in testing tubing, valves and pressure vessels, in the operation of small molding presses, and in other services requiring high pressure at small volume.

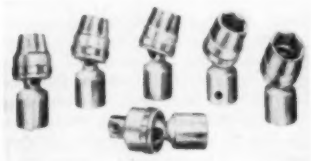
Aldrich Pump Co, Allentown, Pa.



FEEDWATER HEATER P424

Fabricated steel feedwater heater, the *Junior*, has specially designed stainless-steel trays to disperse feedwater in thin curtains over a large area. Exhaust steam heats up the water. Every 11-F increase in feedwater temperature by this means saves about 1% in fuel.

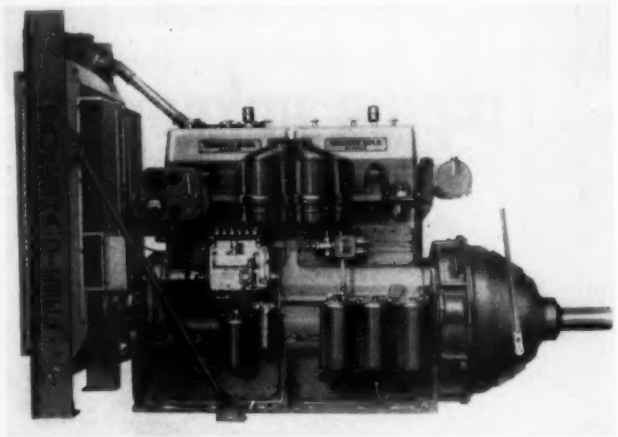
Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio.



UNIVERSAL SOCKETS P443

Five universal power sockets and a universal joint. They are designed for pneumatic or electric power-impact wrenches with ½-in.-square drive, but are equally serviceable on adapter-equipped ⅝- and ¾-in. drive wrenches. Sockets have ½-, 9/16-, ⅝-, 11/16- and ¾-in. hexagon (6-point) openings.

Plomb Tool Co, Washington and Santa Fe, Los Angeles 54, Calif.



6-CYLINDER 4-CYCLE POWER-PLANT DIESEL P412

Maximum continuous output of 201 hp with overload capacity of 272 hp is available from the *Mogul Six* diesel. This 6-cylinder, 4-cycle, solid-injection full diesel has 7-in. bore, 8¼-in. stroke and displacement of 1905 cu in. Recommended for use with high-speed diesel fuels of 45 cetane or above, engine has the spherical combustion-chamber characteristic in all diesels manufactured by this firm. Independent light and power plants are some of the services for which the unit is well adapted. Conversion kit is available for quick changing of the engine from diesel to natural gas, and vice versa, in the field. No internal parts need be changed for the conversion.

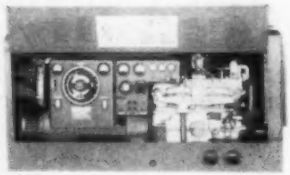
Features include alloy-steel, 7-bearing crankshaft with vibration damper and hardened journals and crankpins; hardened wet-sleeve cylinders; oil-jet piston cooling; aluminum alloy pistons; full-floating piston pins; rifle-drilled connecting rods; full-pressure oiling; full-flow series-connected oil cooler, and many others.

Waukesha Motor Co, Waukesha, Wis.

TILTING MOTOR BASE P416

A lightweight tilting motor base is adjustable in width and length for fractional-horsepower motors. In addition to using it with variable-speed pulleys, it also acts as a belt tightener and can be used for easy belt changing on cone-step pulleys. Speed changes can be made while machine operates.

Lovejoy Flexible Coupling Co, 5141 West Lake St, Chicago 44, Ill.



ARC WELDER P426

Gasoline-engine-driven, 40-volt, 300-amp, self-contained arc welder has a 3-kw auxiliary power generator, a self-starting 6-cylinder, 1500-rpm, 4-cycle Chrysler engine, a battery-charging generator and voltage regulator, plus a mechanical governor control for engine speed. Generator has a current range of 50 to 400 amp.

Hobart Brothers Co, Hobart Square, Troy, Ohio.

For more data on these items, use post cards, p166a. Identify request with P and number.

And Next Month . . .

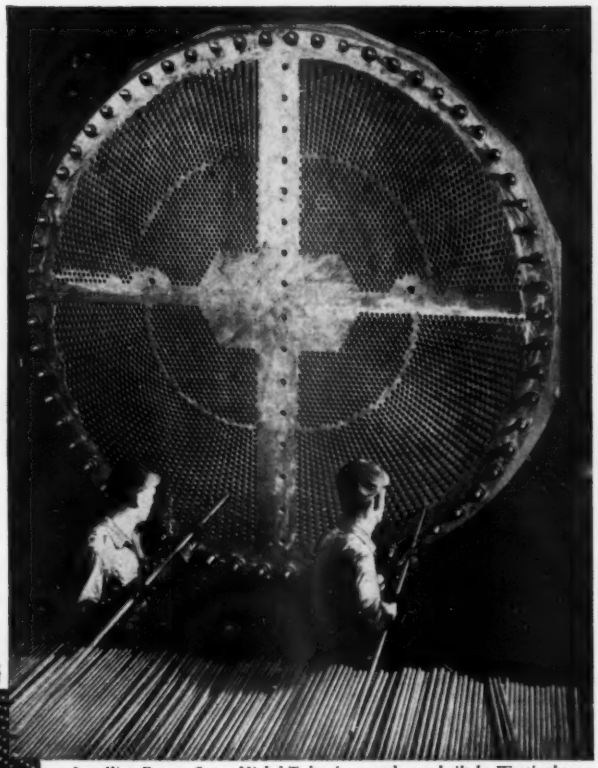
Glass Insulation is now used to increase life of cast-in-concrete reactors. It will stand up under extremely high temperatures without deterioration. This new insulation is free of metallic impurities found in most asbestos tapes.

RECORDER MEASURES ROTOR TEMPERATURE P448

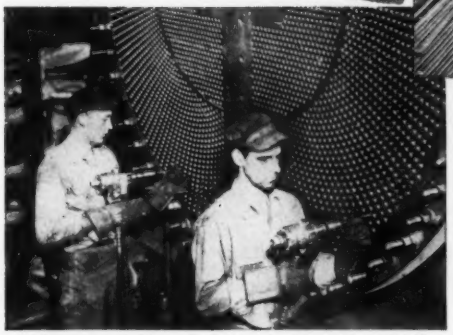
An electronic recorder for accurately and quickly measuring temperature of the rotor in large electric generators. Temperature measurement of the rotating field is of interest because overheating or too rapid cooling can result in costly generator damage. For most economical operation, generators are operated at or near maximum

(Continued on page 162)

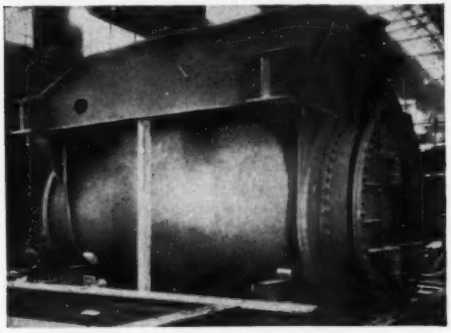
These tubes will stand up...they're REVERE CUPRO-NICKEL



Installing Revere Cupro-Nickel Tubes in a condenser built by Westinghouse Electric Corp., Essington, Pa., for use in a 30,000-ton tanker built for Philadelphia Tankers, Inc., and to be operated by The Atlantic Refining Co. Three of these tankers were built by the New York Shipbuilding Corporation, Camden, N. J.



Rolling the ends of the tubes into the Revere Cupro-Nickel Tube Plates.



Exterior view of one of the tanker condensers. Both main and auxiliary condensers contain Revere Cupro-Nickel Tubes and Plates.

When Philadelphia Tankers, Inc., decided to order three new ships it was determined that they would embody the very best and newest ideas in tanker construction. The final designs included so many novel ideas and important advances that the chief engineer, Dr. Lester M. Goldsmith, was invited to read a paper describing them before the American Society of Mechanical Engineers. However the condenser tubes and tube plates on these ships are thoroughly conventional. These are Revere Cupro-Nickel, the preferred alloy not only for marine use, but in many shore installations where water conditions are difficult. These tubes really stand up.

Whether cupro-nickel should be used on shore depends on the nature of the problems encountered. In some instances another alloy, such as Admiralty, Muntz Metal, Naval Brass, Aluminum Brass may serve as well at less cost in condensers and heat exchangers. Revere will gladly collaborate with you in studying the economics of condenser tube selection as applied to individual installations, new or old.

REVERE 150th YEAR OF SERVICE TO AMERICA

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

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capacity. And since the dc excitation current increases as the load increases, field temperature rises with a rise in load.

Measurement of rotor temperature enables operator to avoid overloads. In addition, a continuous record of the temperature serves as a guide in cooling a generator that has been taken off the line—the field current is reduced gradually to provide a slow cooling rate. This *ElectroniK* instrument provides a continuous record of rotor temperature on a 12-in. strip chart. Recorder is the same in appearance as Brown's standard instruments and the continuous balance system is retained.

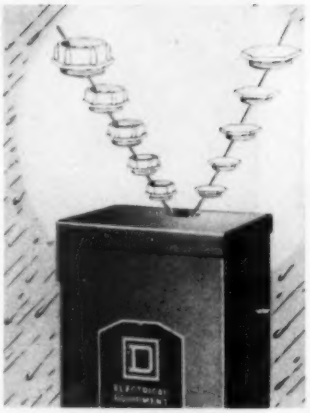
This instrument is essentially a resistance thermometer that infers the temperature of the rotor winding from the measurement of its resistance. Fuses are incorporated in all circuits that connect to the user's equipment to prevent damage to the equipment or to the instrument in a short circuit or component failure.

Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Wayne & Roberts Ave, Philadelphia 44, Pa.

TUBE STAPLES P423

Extra long, copper, *Tube-Tite* staples, in two new sizes, Item No. 304, ⅜-in. nominal tubing and Item No. 305, ½-in. nominal tubing fastens copper tubing to joists through dry board or plaster. Both are round top, round wire with steel cores for strength. They bring the company's line up to five sizes.

E A Tichenor & Co, Binghamton, N. Y.



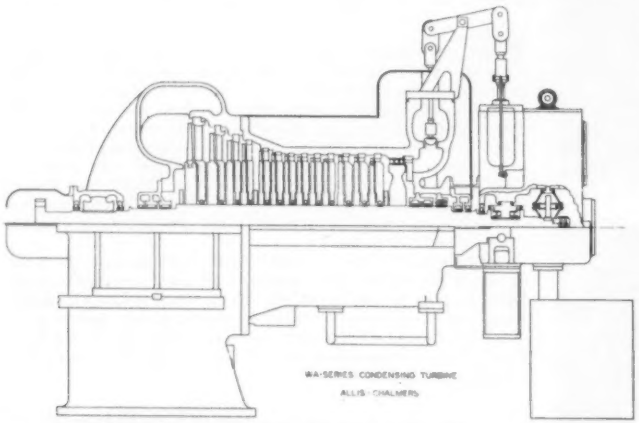
INTERCHANGEABLE HUBS P449

Hubs on raintight circuit breakers, multibreakers, switches and fusible entrance equipment greatly simplify the stocking of raintight equipment. Galvannealed outdoor device has an extruded top which is threaded for the die-cast interchangeable hub. Correct size of hub for conduit is selected and screwed into top endwall.

When no hub is required, a similar die-cast closing cap may be inserted that completely seals the opening.

Square D Co, 6060 Rivard St, Detroit 11, Mich.

For more data on these items, use post cards, p166a. Identify request with P and number.



TURBINE-GENERATOR UNIT P440

WA-Series steam turbine-generators, developed in 500- to 7500-kw ratings. High-speed, compact, streamlined with economical regenerative feedwater heating cycles. They can also be tied-in thermodynamically to provide a steam-power balance where low-pressure process steam is utilized. Governor and regulating characteristics provide for paralleling with existing units and tielines.

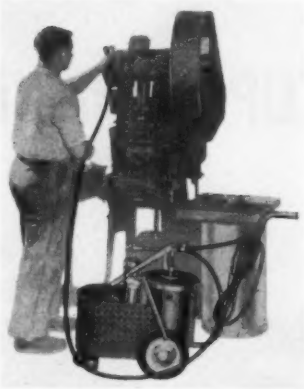
Design features include simplicity of three-bearing unit construction with quality multistage impulse turbine, housing-type generator, and direct-connected exciter construction.

Allis-Chalmers Mfg Co, S. 70th St, Milwaukee, Wis.

ROTARY PUMP P419

Totally enclosed rotary pumps are available in capacities of 20 to 92 gpm. They are suited for pumping all types of clean liquids, either indoors or outdoors. Totally enclosed with oiltight, watertight guards, these pumps can be safely used outside in all kinds of weather without a pump house or protection of any kind when equipped with a totally enclosed motor. These pumps have oiltight, cast-iron gear case with oil gage, filler and drain plug, stainless-steel pump shaft, no rusting if exposed to weather, and extra long stuffing box on pumps, rustproof studs and nuts.

Viking Pump Co, Cedar Falls, Iowa.



GREASE RIG P442

Lube service cart, for dispensing lubricants to industrial bearings. This 2-wheeled grease rig moves rapidly along plant aisles and between closely placed production machines. Since all grease and oil equipment on the rig is removable, even remotely located machines, inaccessible to cart, can be greased with its equipment.

When stocked with grease and oil for general-purpose lubrication (and specialized grease if desired), the Graco Lube Service Cart is a completely self-contained unit requiring no air supply; all hand operated.

Two models are available. One dispenses grease from a bucket-type unit, which holds 30 lb of grease. The other pumps from a 25- to 40-lb refinery filled pail. Each has a 10-ft high-pressure hose with control valve. Both models feature high pressure and volume greasing.

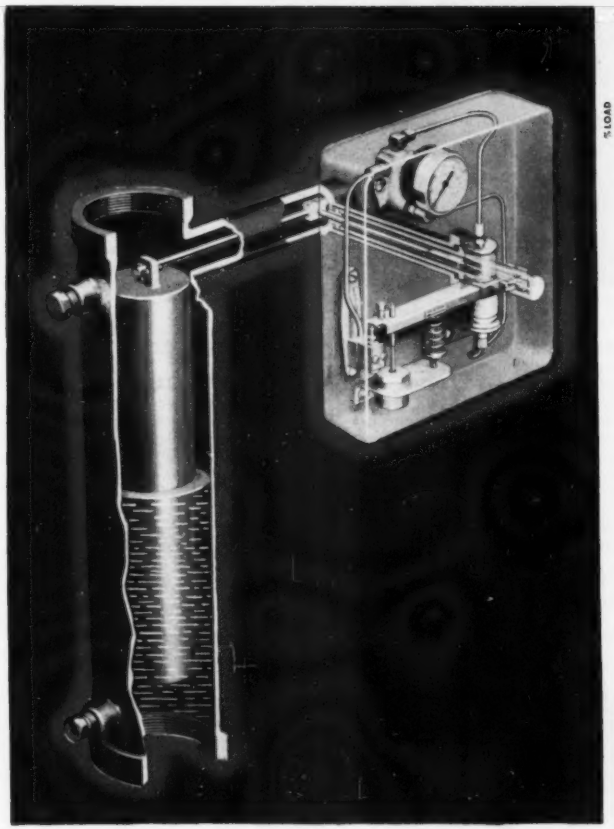
Gray Co, Inc, 200 Graco Square, Minneapolis 13, Minn.

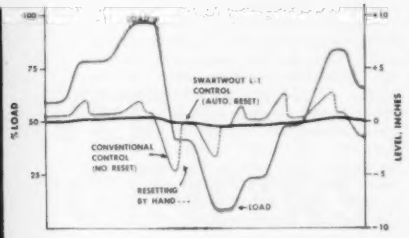
ELECTRONIC RECORDER P437

Range is continuously adjustable over a 20:1 ratio. Zero suppression is adjustable over more than twice the maximum range. Through use of a particular suppressed zero range an operator can ignore that portion of the range he is not interested in. At the same time he can spread the few millivolts he wants to watch across the entire width of the instrument chart.

(Continued on page 164)

Hold liquid levels within ±1/2 inch automatically with Swartwout L1 Displacement Type Controls



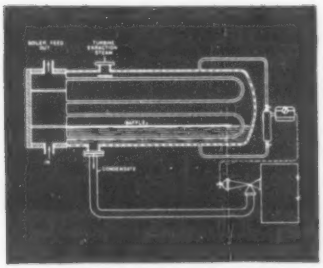


1 Precise control of liquid level from no load to full load without manual readjustment is provided by Swartwout L1 Controls. Setback and reset features compensate for quick-changing loads or long process lags . . . eliminate any tendency to cycle or hunt, yet permit control within narrow range of ±½ inch. Graph *(above)* shows precision of L1 compared with conventional control on applications where level must be maintained within ±½ inch.

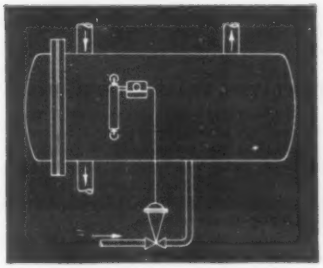
Operating on balance of forces principle, there is little actual movement of parts. Torque tube design eliminates stuffing boxes . . . gives continuous leakproof operation. Since changes in liquid level vary effective weight of displacement type float, L1 Controls can also be used for throttling over full length of float, available in lengths from 15 to 120 inches. A-2006

Swartwout

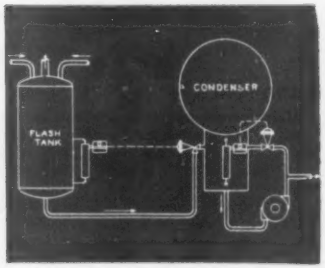
POWER PLANT EQUIPMENT



2 Horizontal Subcooled Heaters—L1 Control holds level to ±½ inch, never lets condensate cover tubes that should be exposed to steam . . . never exposes tubes that should be covered with condensate.



3 Evaporators—Swartwout L1 Displacement Type Control holds level within ±½ inch . . . prevents carryover of solids and contamination of boiler feed water. Increased plant efficiency results.



4 Flash Tanks—Level maintained, in some installations, by L1 Control draining to condenser. Hot well level precisely maintained by controlling condensate recirculation from pump discharge.

SEND FOR BULLETINS S-15-A, S-208-A • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

Adjustable range permits user to select his own scale calibration at will.

Typical measurements include: (1) Measurements with strain gages for experimental stress analysis, weighing operations, etc. Adjustable zero compensates for tare weight. (2) Temperature difference measurements with thermocouples in measuring small temperature changes at high temperatures. (3) Speed measurements using an electric tachometer as the primary element. This recorder can measure change of speed over a narrow range or assist in the study of speed regulation characteristics of motors, engine governors, etc.

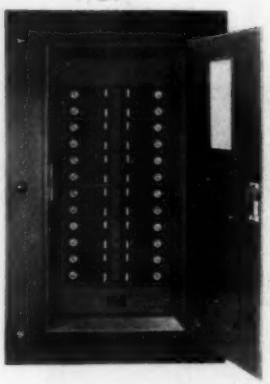
Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

TEST LIGHT P444

Lo-Volt Test Lite, Model #1300, is encased in a plastic housing that will stand abuse. Flexible leads with heavy, durable coverings 10 in. long are terminated in convenient spring clips.

Plastic bulb lights up in an easily seen brilliance on any voltage from 3- to 25-volts ac or dc. It is especially adaptable for low-voltage controls such as thermostats, etc, and may also be used with a battery supply to test for continuity. A second model is offered as the *Lo-Volt Test Lite*, Model #1310, covering a range from 6- to 50-volts ac or dc.

Industrial Devices, Inc, Edgewater, N. J.



FUSIBLE PANELBOARD P433

Units provide plug-fused branches with heavy-duty toggle switches for lighting and appliance circuit control. NTPR panelboards are available from 4 to 40 circuits for either ac or dc applications. They carry the approval of Underwriters' Laboratories, Inc.

Construction features embody a 17-wide x 4¼-in.-deep box with 4-in.-wide wiring gutters. Four branch circuits are contained in the high-strength, one-piece molded bakelite blocks.

Square D Co, PO Box 272, Roosevelt Park Annex, Detroit 32, Mich.

Wait! . . . Take Another Minute to Check These

Electric Vibrator for bin, hopper and chute. They are semi-noiseless; hence suitable for interior application ..... p 176

High-Pressure Centrifugal Pump requires small floor space. Suitable for general industrial use where the liquids are noncorrosive to iron and bronze ..... p 178

Outdoor Floodlights made up in a weatherproof cluster suitable for protective lighting. Unit uses standard outdoor weatherproof reflector bulbs ..... p 180

Grease Pump Kit for reloading individual bearings and centralized lubricating systems. Electrically operated barrel pump is mounted on 400-lb grease drum ..... p 182

MAGNESIA INSULATION P410

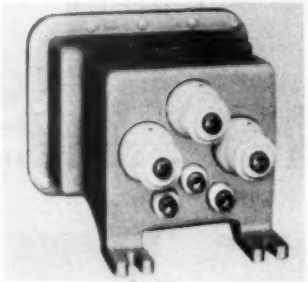
The number of basic sizes in which *Thermalite* 85% magnesia pipe covering is now manufactured has been greatly reduced. This material comes in sectional form with thicknesses revised so every size pipe covering will fit precisely over or into another basic pipe size. *Thermalite* registers a considerably lower density than before, has a thermal conductivity lower and well within needs of all recognized "specs."

Ehret Magnesia Mfg Co, Valley Forge, Pa.

HAND PUNCH P4077

Quick, accurate, on-the-job cutting of washers and gaskets from leather, rubber, canvas, felt, soft brass, copper, lead and other light materials is possible with the self-centering *Centr-O-Punch*. A receding pointed plunger marks dead center when the first or outside cut is made so positioning for the second or inside cut is accurately established. The material is automatically ejected with each cut. No clogging of barrel to cause loss of time and efficiency. Cutter sizes range from ¼ to 1 in. for single cutters and, in the larger sizes, up to 2½-in. dia.

Rini Metals Co, Dept J2, 1518 Walnut St, Philadelphia 2, Pa.



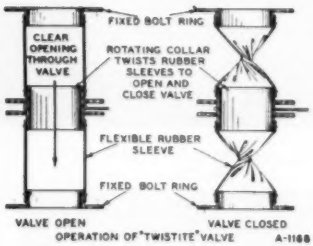
INSULATING TRANSFORMER P450

Telephone-insulating transformer was designed to protect low-voltage telephone circuits and equipment—and the maintenance personnel who work on them—from momentary high-potential surges, such as are encountered on exterior telephone lines paralleling power circuits.

Operating at frequencies from 20 to 30,000 cycles, this telephone-insulating transformer is oil-immersed in a lightweight, sealed aluminum case.

Federal Telephone and Radio Corp, 100 Kingsland Road, Clifton, N. J.

For more data on these items, use post cards, p166a. Identify request with P and number.



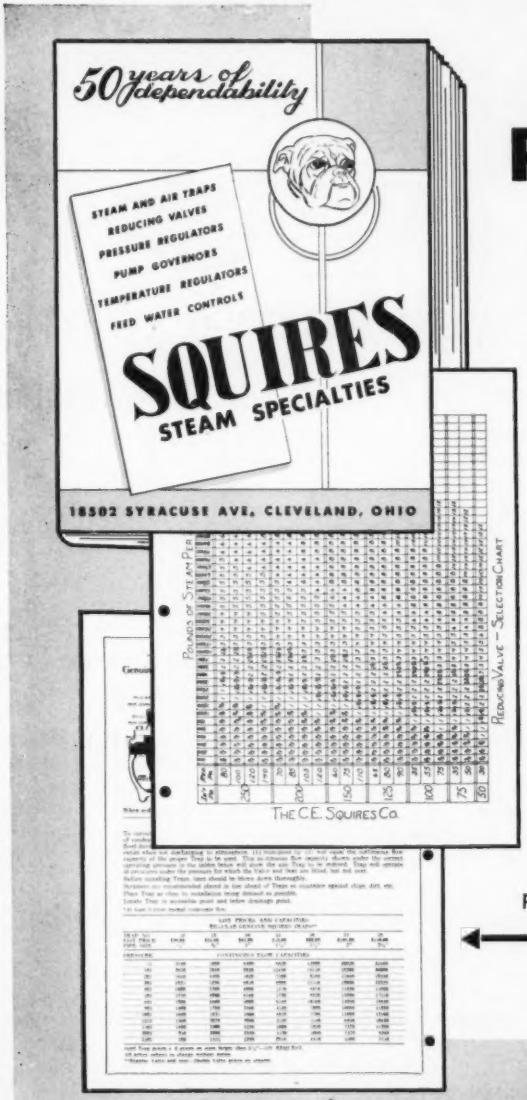
BIN VALVE P411

Twistite double-closure bin valve has two rubber sleeves joined by a rotating steel collar. Dust- and drip-tight closure obtained by pulling on cable wrapped around rotating collar. Valve is self opening; elasticity makes rubber sleeves resume cylindrical shape as soon as cable tension is released. Sleeves wrap around lumps, prevent leakage. Local or remote hand control can be used for valve. Small actuating motor gives automatic control. Standard 6-in. valve weighs 35 lb, handles lump sizes up to 2½ in.; other valve sizes available on request.

Stephens-Adamson Mfg Co, Aurora, Ill.

(*Continued on page* 176)

NEW! Valuable Reference



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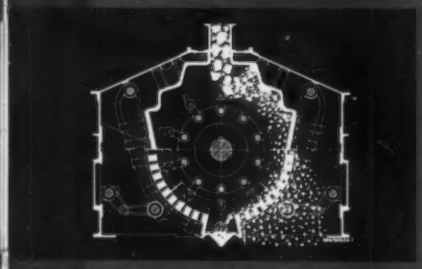

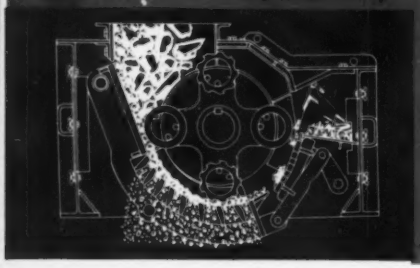

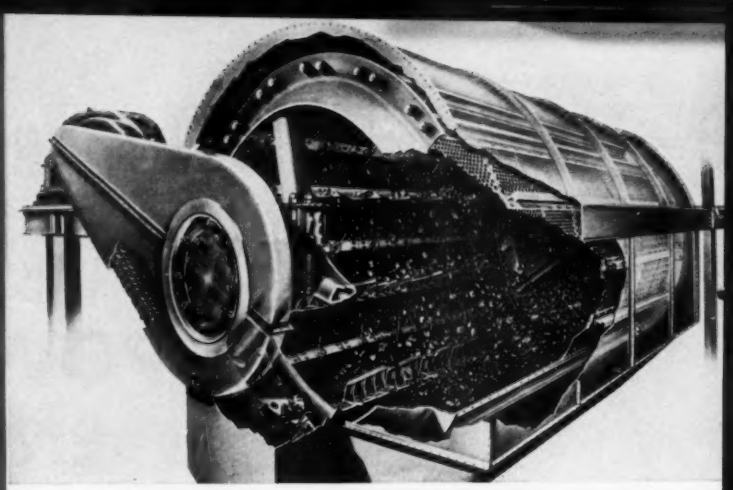

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In the majority of central stations throughout the U.S.A. Pennsylvania Bradford Breakers are standard equipment for crushing, sizing and scavenging run-of-mine coal. In approximately 65% of these installations a "stand-by" crusher is not even considered—undisputed proof of the reliance placed on the dependability of a Pennsylvania Bradford Breaker. Ruggedly built, operating at slow speeds and crushing by gravity impact, maintenance costs are practically nil. Send for bulletin 3007.

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B3 **DRY-FAN COOLING TOWERS** — Two 4-page bulletins Nos. 46 and 47 describe Binks No. 2-B Series dry-fan cooling towers with capacity range 3 - 30 tons of refrigeration; and Binks No. 2-BB Series with double inlet squirrel cage duplex blower capacity range 32 - 60 tons of refrigeration. Binks Mfg Co, 3114-40 Carroll Ave, Chicago 12, Ill.

B4 **AMMONIA CONDENSERS** — Frick vertical shell-and-tube condensers, Type VS, are featured. Details of construction and typical installations are also given. 8-page bulletin No. 228-E. Frick Company, Waynesboro, Pa.

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B5 **OIL BURNER PRODUCTS** — Lists and illustrates oil burner products including automatic horizontal rotary burner, steam turbine driven design, combination gas-oil, semi-automatic, and pressure atomizing types. Gives selector chart, plus specifications and capacities. 16-page catalog. Ray Oil Burner Co, 401-499 Bernal Ave, San Francisco 12, Calif.

B6 **COAL CRUSHERS AND PULVERIZERS**—Shows how coal is split, not crushed, by the firm's rolling ring principle. Contains facts and informative data on American coal crushers and pulverizers. 8-page bulletin. American Pulverizer Co, 1349 Macklind Ave, St Louis 10, Mo.

B7 **PULVERIZERS** — Detailed information about Mikro pulverizers. Includes test grinding and dust collecting data sheets, as well as a list of some of the materials to which Mikros are applicable. 60-page catalog. Pulverising Machinery Co, Chatham Road, Summit, N. J.

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B11 MOTORS AND CONTROLS—Describes 600 Series mill motors and Class 9500 dc magnetic mill auxiliary controllers. Design features and construction details discussed with sections devoted to armatures, bearings, field coils, brushholders, ventilation. 20-page booklet No. B-4730. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

MAINTENANCE AND SAFETY EQUIPMENT

B12 PIPE AND BOLT MACHINES—Pictures and describes features of portable pipe and bolt machines, power drives, as well as the pipe cutter and pipe threader designed for use with electric power drives. Brochure No. PM-150. Beaver Pipe Tools, 350-650 Dana Ave, Warren, Ohio.

B13 HYDRAULIC OIL PURIFIERS—Tells how to stop downtime, mechanical failures and expensive repairs on hydraulic equipment caused by contaminated hydraulic oils. 8-page bulletin. Honan-Crane Corp, 200 Superior Ave, Lebanon, Ind.

B14 HOT WATER CIRCULATION—Describes hot water piping arrangements used in buildings. Also discusses the circulation of hot water and tells how to overcome the various operating difficulties that interfere with such circulation. Data sheet. Water Service Labs, 423 W 126th St, New York 27, N. Y.

B15 FLEXIBLE CONNECTIONS — High temperature ball bearing swivel fittings for use as flexible connections for oil burners. Operating instructions and repacking information. 4-page bulletin. Rasmussen Mfg Co, 12339 Industrial Ave, Hollydale, Calif.

★ **CUTTING FLUIDS** — Factual data concerning more than 50 metalworking jobs. Descriptions of Sun straight and emulsifiable cutting oils included. Charts show correct cutting fluids for metals and metalworking machines. 80-page booklet. Sun Oil Co, 1608 Walnut St, Philadelphia 3, Pa. (*Write direct to manufacturer on company stationery giving name and title.)

B16 GAGE GLASS—Data on Sondergglass, either clear or reflecting type. Material consists of two layers of glass made of semi-metallic substances with different degrees of expansion. Price list. 4-page leaflet No. 10M1148CP. A W Chesterton Co, 6 Ashland St, Everett 49, Mass.

MAINTENANCE MATERIALS

★ **VINYL PLASTIC COATINGS**—Vinyl plastic coatings for the control of corrosion on exteriors of steel, concrete, brick, formed block and plywood structures. Specific properties, chemical resistance chart, information concerning application included. 10-page bulletin. Casey & Case Coating Co, P O Box 151, Maywood, Calif. (*Write direct to manufacturer on company stationery giving name and title.)

B17 INDUSTRIAL HOSE—Engineering data, construction specifications and other information designed to aid engineers in the selection and care of fire hose and general industrial hose. 16-page catalog. New York Belting & Packing Co, 1 Market St, Passaic, N. J.

B18 COLLOIDAL GRAPHITE COMPOUND—How colloidal graphite compound dispersions are used in metalworking, glass, rubber, and corrugated boxboard industries. Gives details of specific applications. 5-page bulletin No. 427. Acheson Colloids Corp, Port Huron, Mich.

B19 HEAT RESISTANT PAINT — Contains complete technical and application data on Heat-Rem H-170, an extra high heat resistant aluminum paint capable of withstanding temperatures up to 1700 F. Bulletin No. TD 513500. Speco, Inc, 7305 Associate Ave, Cleveland 9, Ohio.

B20 MECHANICAL PACKINGS—Describes Chesterton mechanical packings. Illustrates 14 proven styles which simplify all packing problems. 4-page bulletin No. 15M. A W Chesterton Co, 6 Ashland St, Everett, Mass.

B21 HEAT TRANSFER TUBES — Gives construction of Brown integral one-piece fintubes. Also range of sizes and materials in which they are available, heating and cooling applications, engineering data. 8-page bulletin No. 511. Brown Fintube Co, Elyria, Ohio.

B22 MECHANICAL SEALS—Data on Garlock mechanical seals for rotary shafts. Several standard constructions are shown, also typical and special applications, and installation. 12-page booklet No. AD 144-15M. Garlock Packing Co, Palmyra, N. Y.

MATERIALS HANDLING

B23 LIFT TRUCKS — Complete data on Towmotor fork lift trucks including capacities, load centers, lift heights, weights, dimensions, etc. 4-page bulletin No. F2. Towmotor Corp, 1226 E 152nd St, Cleveland 10, Ohio.

B24 COAL HANDLING—Booklet, entitled "Economic Coal Storage," is a training aid on safe, orderly coal handling methods. 7-page booklet No. MS-872-5012. Allis-Chalmers Mfg Co, Tractor Div, Milwaukee 1, Wis.

B25 COAL HANDLING — Describes modern central station coal handling practices as portrayed by recent installations; illustrates individual units of equipment. Complete with diagrams, dimensional drawings, etc. 20-page bulletin No. 103. C O Bartlett & Snow Co, 6200 Harvard Ave, Cleveland 5, Ohio.

B26 MAGNETIC SEPARATOR—Features the Eriez magnetic hump designed to remove tramp iron from materials conveyed in pneumatic, gravity flow or liquid lines. Includes construction and application data, engineering diagrams, etc. 4-page bulletin No. 703. Eriez Mfg Co, Erie, Pa.

MECHANICAL TRANSMISSION

B27 PILOTED COUPLINGS — Illustrates and describes the application of Falk speed reducers, couplings, gears and Motoreducers in specific industries. Geared power transmission applications shown with line drawings and photographs. 6-page bulletin No. 4115. The Falk Corp, 3001 W Canal St, Milwaukee 8, Wis.

B28 FLEXIBLE SHAFT COUPLINGS —Information on Link-Belt RC flexible shaft couplings includes dimen-

(Continued on page 220)

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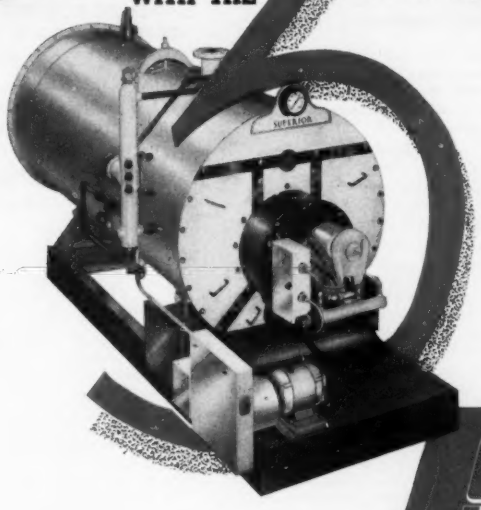

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THE WATER AND THE POWER
STEAM TURBINES
THE ENGINEERING METHOD
MECHANICAL ENGINEERS' HANDBOOK
INTRODUCTION TO SERVOMECHANICS
ENGINEERING MECHANICS
THEORY, APPLICATION OF ELECTRONICS
CIRCUIT ANALYSIS: AC POWER SYSTEMS
ION-EXCHANGE RESINS
FUELS AND COMBUSTION HANDBOOK
BASIC ELECTRICAL MEASUREMENTS
TELEVISION SERVICING
TRANSFORMER ENGINEERING
THE PRACTICE OF LUBRICATION

FEATURED THIS MONTH

Up-to-Date Handbook on Mechanical Engineering

MECHANICAL ENGINEERS' HANDBOOK (*5th edition*). *Edited by Lionel S Marks, Gordon McKay professor of mechanical engineering, emeritus, Harvard University.* 2236 *pp,* 9¼x6, *illus, tables,* $15. *McGraw-Hill Book Co,* 330 *W 42nd St, New York* 18.

This new edition of the well-known handbook goes far toward covering the field of mechanical engineering in a comprehensive manner. As in earlier editions the aim is to serve the needs of engineering students and practicing engineers. Nature of the discussions makes the book valuable also to nonprofessional workers in the engineering field seeking technical information.

The book covers fundamental theory of the various divisions of the field as well as supplying the best available data on the properties of materials. Also included are typical performances and characteristics of processes and structures designed, built and operated by mechanical engineers. More than 100 engineers cooperated in preparation of the revised handbook, each a specialist in his field.

World War II caused significant strides in the advancement of engineering technology beyond some of the material contained in the earlier edition. This edition includes the more important information developed in the older fields as well as the entirely new fields and machines. These categories include:

Theory—fluid mechanics, elastic and plastic deformation of materials, stresses in turbine disks, transonic and supersonic aerodynamics, aircraft jet propulsion, rockets, radar, television.

Processes—radiant or panel heating, solar heating, heat pumps, vapor-compression distillation, high-vacuum pumps, modern casting methods, dust explosions, industrial supersonics, machining of plastics, automatic process control, statistical quality control.

Materials—ferrous and nonferrous alloys, superalloys for high temperatures, plastics, elastomers, silicones, adhesives, fibers, explosives, rocket fuels, reflective heat insulation, powder metallurgy.

Power—gas turbines, atomic power.

The book divides into 16 main sections entitled: mathematical tables and weights and measures, mathematics, mechanics of solids and liquids, heat, strength of materials, materials of engineering, fuels and furnaces, machine elements, power generation, hoisting and conveying, transportation, building construction and equipment, machine shop practice, pumps and compressors, electrical engineering, engineering measurements, mechanical refrigeration, etc.

The handbook is well indexed, taking up a total of 82 pages for this section so specific items can be found quickly.

Turbine Design

STEAM TURBINES (*3rd edition*). *By Edwin F Church, Jr, professor of mechanical engineering, Polytechnic Institute of Brooklyn.* 531 *pp, illustrated, tables,* 9¼x6½, $6. *McGraw-Hill Book Co,* 330 *W 42nd St, New York* 18, *N. Y.*

For class use by engineering students in turbine design. Many new sections increase the value of the book for graduate study. Text has been largely rewritten and in part rearranged. This edition drops references to design practices now considered obsolete, but adds much more new material that increases the size of the volume.

Compared to the previous edition, this one includes new data on blade and nozzle tests derived from improved experimental methods, more general treatment of blading theory and performance with various degrees of reaction, variations of fluid flow through nozzles and blades at different radii, twisted blades, elementary aerodynamic theory, effects of sonic and near-sonic velocities on steam flow in turbines, vibrations and their control, variation in turbine forms, turbine structural elements as affected by steam condition, capacity and speed, turbine governor forms, performance data.

Great River Systems

THE WATER AND THE POWER (1951). *By Albert N Williams.* 378 *pp,* 5½x8½, 32 *maps,* 16 *photos, cloth.* $4.50. *Duell, Sloan & Pearce, Inc,* 270 *Madison Ave, New York* 16, *N. Y.*

Water has shaped the history of western United States, and today is shaping its future. Those who doubt this statement will find much in this book to prove its truth. It gives a brief history of development of the five great river systems: the Colorado, Sacramento and San Joaquin, Rio Grande, Missouri, and Columbia. It shows in the patterns of the varied developments the grave problems that face the citizens of two-thirds of this country in a time of dwindling water supplies and a rapid increase in municipal, industrial and agricultural use.

Each chapter is a compact picture of a western region giving historical background, development of the river systems, their effects on land and people, and an account of river economics and politics that make vital issues today. Much is said against the power trust, the Army Engineers and the Bureau of Reclamation, and in favor of Tennessee Valley Authority, and of similar government agencies to develop the Missouri and Columbia Rivers. Aside from this apparent bias the book is well written and contains a wealth of valuable facts on the five river systems treated.

Mechanical Design

INTRODUCTION TO MECHANICAL DESIGN. *By T B Jefferson, editor, The Welding Engineer, and Walter J Brooking, M W Kellogg Co.* 612 *pp,* 6x9. *cloth,* $6.50. *The Ronald Press Co, 15 East 26th St, New York 10, N. Y.*

Most power engineers run into occasional jobs involving design of simple machines or machine parts. And operation and maintenance go a lot better when the engineer has some knowledge of the general principles of design. For them this book should be useful, since it covers the broad field of mechanical design in a simplified and straightforward fashion.

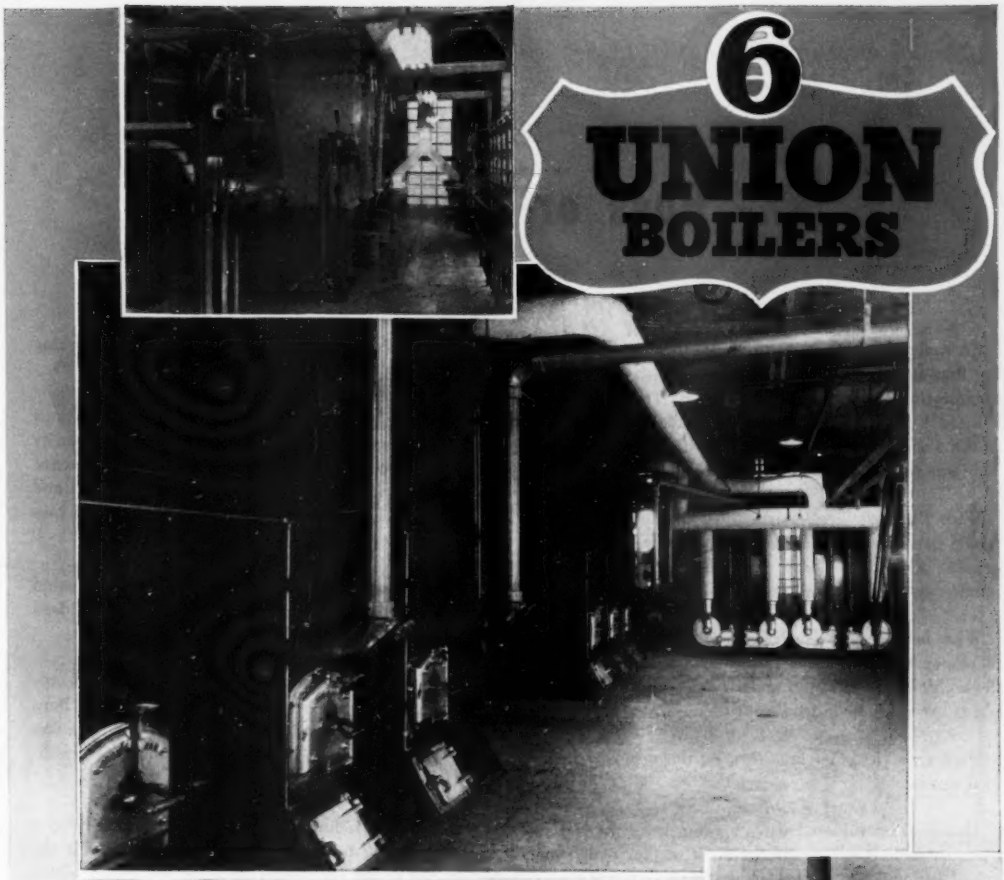
The authors begin by telling what machines do and how they are designed. Then they tackle basic design principles and the properties of materials used in construction. Other chapters cover machine elements: bolted and riveted connections, welded joints, machine frames, shafting, keys and couplings, bearings and lubrication, gearing, brakes, clutches and flywheels, belt, rope and chain drives, cams and linkages, springs, piping and containers, etc. Discussions throughout are clear and fully illustrated.

Television Servicing

TELEVISION SERVICING. *By Walter H Buchsbaum.* 6½x9½, 340 *pp,* $5.35. *Prentice-Hall Inc,* 70 *Fifth Ave, New York* 11, *N. Y.*

Although this book was written with the TV serviceman in mind, the power engineer in institutional buildings will do well to master the basic principles. TV is becoming more a part of the hotel, hospital and school and the broad technical mainte-

(*Continued on page* 206)



6 UNION BOILERS

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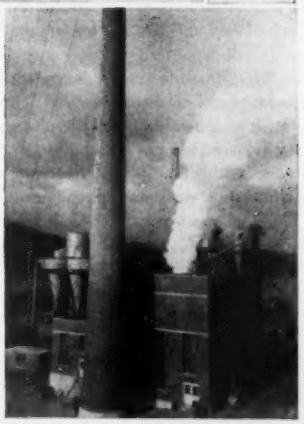

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BOILERS • PROCESS EQUIPMENT • FABRICATED STEEL

Boss or Leader?

"A dying fish first starts to stink in the head"—meaning that an incompetent or misguided boss can put any organization on the skids. That's the old Turkish proverb Willard V Merrihue of GE used to drive home his point at the Pacific Coast Electric Association's last meeting. This was held in Honolulu for the first time.

Wish I'd been there. I like those palmy Pacific isles. Also I like Merrihue's common-sense advice to bosses in general. His job is people, and he must be good at it, judging by the sound advice he handed out.

What he told the Association would be worth a barrel of money to some bosses I have met. I am referring to those chief engineers who understand everything in their plants except the men who work there.

Here are a few Merrihue tips, set down mostly in my own words:

The good boss doesn't drive a chain gang; he leads a team. He understands people, knows what they really want out of life and ties his leadership to these wants.

What does the average worker want most? Two things, *security* and *achievement*. Security means more than mere freedom from want and the fear of it. Security means confidence in the boss and always knowing just where you stand with him. If you don't know what the boss likes about your work—and what he doesn't like, and why—you don't rest easy. You don't know how far you dare go with new ideas and suggestions.

So your ambition to achieve something important and noteworthy is frustrated. Same with your fellow workers. That kind of boss will never have a real team working with him.

Under the right boss, workers feel secure, know just where they stand. In an atmosphere of friendly security they blossom out, show initiative, suggest improvements, become an effective plant team. And they are happy and satisfied in their work, having both security and the joys of achievement.

The good boss, says Merrihue, can make up his mind and not take forever doing it. He's a live wire, not a dead fish. The men will reflect this spirit.

Also he has personality—a manner that attracts people instead of driving them away. But if you weren't born with the salesman's come-hither, don't despair; you can develop personality by observing and practising the qualities that people like to see in other people.

The boss who follows these sensible rules will build a loyal team ready to back him up in any reasonable endeavor. But to get full results he needs two things more: (1) to know what ought to be done and (2) to let everybody know what he is trying to accomplish and how things are going. There's no sense in trying to hide the score from your teammates. That's no way to win a game of football. And it's no way to get results in plant operation and maintenance.

So, Mr. Good-power-plant-boss, top off your other fine qualities with a little sharing of the planning and the responsibility. Call the boys in. Tell them what you are shooting for, and get the whole crew working *with* you and *for* you.

George Edwards

Engineer

Just in case...

Just a little fever, but you called in the doctor—just in case. Perhaps all he did was write out a prescription for some pink pills, but if it had been serious, it was nice to know Doc was there. What the doctor does is important—*but what he knows how to do is more important—just in case!*

An experienced maintenance cleaning service company is somewhat like a good doctor. What they do on a particular job is important—but, even more important, is what they know how to do—just in case. A great many jobs are routine and can be handled as such. It's those complications that can cause the trouble.

Dowell pioneered the service use of chemicals to clean heat exchange equipment. Thousands of successful jobs have led to the improvement of techniques, materials and equipment . . . and the expansion of cleaning methods to many new applications. Over a decade of working in all types of plants—from coast to coast—has provided the background of experience that is always on any job . . . just in case.

The next time you have a maintenance cleaning problem, call Dowell. Whether it's a boiler or a process tower, a water line or a water well, Dowell offers the experience and dependability that are your assurance of a good job.

Dowell Incorporated

TULSA 3, OKLAHOMA

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★ *Chemical services for oil, gas and water wells.*
★ *Magnesium anodes for corrosion control.*
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	RICHARDSON	OR EQUAL
Coal Scale Inlet	20" x 20"— Coal won't arch above opening.	
Coal Stream Leveling	Pivoted; allows large lump passage.	
Weigh Hopper	Flapper seal to retain fines and prevent lumps from "hanging up" scale.	
Hopper Discharge Mechanism	Foolproof, mechanical. No encumbering solenoid boxes or wire to alter weighing.	
Weigh Beam	Fully accessible. Warp and twist-free.	
Register:	Mechanical, direct-connected discharge counter. Impossible to double count. Motor driven remote counter available.	

Available for special applications including elongation for service as a coal conveyor. A complete line of accessories is also available—such as Magnetic Head Pulley, Automatic By-Pass etc.

Without obligation a Richardson engineer will be glad to survey your present methods of checking fuel consumption and boiler efficiency. His recommendations, based on almost 50 years of materials handling by weight experience may be the means of cutting your fuel costs.

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7634

TECHNICAL BRIEFS

(*Continued from page* 156)

SMOKE MEASUREMENT IN A FUEL-OIL TEST UNIT, *by D W Locklin and G B Parmelee, ASHVE Research Laboratory.* Present-day methods of producing gasoline from crude oil have greatly affected the chemical composition and physical structure of the byproduct going to the fuel-oil industry. Some years ago oil-burner fuels were the product of straight-run distillation or thermal cracking processes. Experience shows that burning properties of such fuels are different from those of fuels reaching the market today. To permit proper selection of fuel for domestic oil burners particularly, some method of determining burning characteristics of fuel oil is needed.

This paper and a companion paper summarize investigation and tests on a unit by Oil Heat Institute of America.

This particular paper confines itself to the measurement of smoke resulting from oil-burner operation and methods of testing for that smoke. The authors found smoke indication by filtration and light transmission methods did not bear a consistent relationship. Of the two, the filtration method evaluated by photometric reflectance was the most suitable. *ASHVE paper. No number.*

Directions for ordering papers on p 156

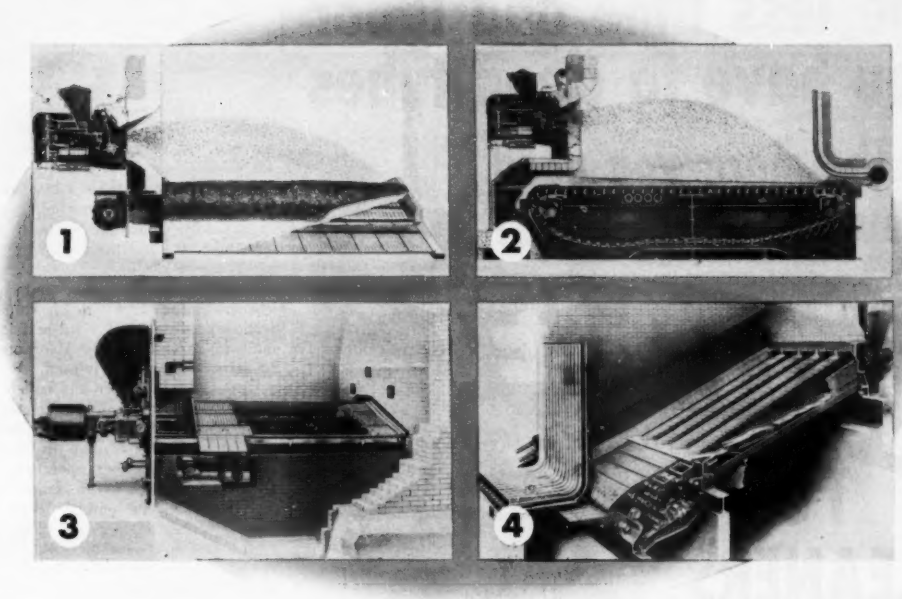
RATING OF FUEL OILS BY A TEST UNIT, *by D W Locklin and G B Parmelee, ASHVE Research Laboratory.* This is a companion paper to *Smoke Measurement in a Fuel Oil Test Unit* by the same authors.

The oils are rated on the basis of their smoking tendency at given rates of air supply. Purpose of the test was to rate oils with regard to their burning characteristics. The first approach was to run tests so all oils were used under identical conditions. It was found impossible to do this, however, because to establish a constant weight rate of oil flow through the burner nozzle required a change in oil-line pressure to compensate for density and viscosity.

The authors have worked up a series of curves showing smoking characteristics of oil against CO_2 for several test oils. The characteristics of these test oils are shown in a table.

The authors found that in addition to increasing firing rate, the effect of increasing delivery pressure of oil was to produce a cleaner combustion and a slightly shorter flame. To switch ignition off during steady operation resulted in an increase in air-supply rate and smoke production. Smoke density during shutdown was greater than during

(*Continued on page* 196)



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1. *Centrafire with Link-Grate*
The Centrafire with Link-Grate is a unique spreader-type stoker for medium capacities to upward of 50,000 pounds of steam per hour. Fuel feed is continuous. Link-Grates move the burning fuel toward the side walls. Refuse is discharged without reducing load or losing steam pressure.

2. *Centrafire with Traveling Grate*
A spreader-type stoker with traveling grate for the larger Central Station and industrial plant. Maximum capacity upward of 350,000 pounds of steam per hour. Same fuel feeding and distributing mechanism as Centrafire with Link-Grate. Forward-moving traveling grate for continuous discharge of ash.

3. *Link-Grate Single-Retort Stoker*
The Link-Grate Single-Retort Underfeed Stoker is an economical means of burning many coals for the small installation. Link-Grate motion maintains an active, porous fuel bed for efficient coal burning with a minimum of attention.

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A clean stack and outstanding efficiency are characteristic of the Link-Grate Multiple-Retort Underfeed Stoker for the larger installation where fuel is suited to underfeed type firing. Link-Grate motion and continuous ash discharge permit heavy, continuous loads.

Call your nearby Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa., for complete information. J-50523

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The less time and labor you have to clean tubes

The more you need New, Powerful, Fast

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TUBE CLEANERS

ROTOJET Air-driven Motor Model 525 with short 4-arm head and universal joint for 2⅝" to 3" I.D. curved tubes.

So powerful is the new Rotojet Motor that we have yet to find a scale-removal job tough enough to stop it. The simple, rugged Rotojet, with our exclusive Rotocentric bore cylinder, uses air sparingly. No leakage, no stalling at low speeds. Labor-saving air valve permits one-man operation. Try Rotojet and you'll never want to use any other make cleaner.

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ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue **Newark 1, N. J.**

RIDGELAND

(*Continued from page* 87)

Each boiler has two drum-level gage glasses. Utiliscope televises one to the control room. A telemetered drum-level recorder, a component of the 3-element feedwater control, supplements the first two. Number of alarms and automatic protective equipment exceeds those used in previous installations. Photo-cell-actuated alarms indicate loss of ignition in cyclone furnaces. Audible alarms on the annunciator system are used only in the central control room. Alarms group into major and minor systems. Large "area" trouble lamps on sections of the control board help locate individual trouble lights. Motor-operated valves are extensively used.

Cyclones can be fired and boilers put in service (except for drain-valve operations) from the control room. An attendant brings the turbine up to speed at the unit, but other operations are made remotely. Circulating-water pumps, condensate pumps, boiler-feed pumps, turbine oil pumps and exciters are all remotely controlled. Emergency operations, such as sectionalizing steam and feedwater headers, bypassing coal scales and feedwater regulators, isolating feedwater heaters and transferring boiler feed pumps, can all be done from the control room.

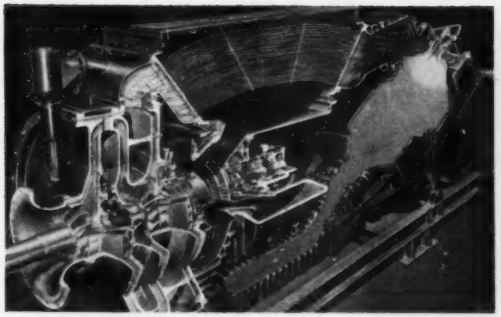
Intercommunication. Two public-address systems supplement normal telephone service, one for the coal-handling plant and another for the station generally. The two systems consist of 68 microphones and 115 speakers. There are twelve 150-watt amplifiers. Microphones stand at strategic points near equipment and near speakers. A carrier current system from bridge crane to various parts of the coal-handling system is a unique feature.

Electrical System. All power will be fed directly into two 69-kv transmission systems through two transformer banks for each unit. Each bank has three 13.2-69-kv single-phase transformers with a combined forced-air-cooled rating of 100,000 kva.

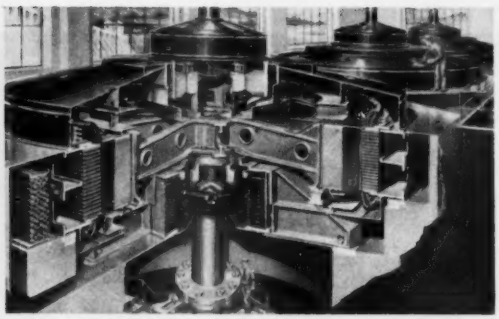
Heavy, isolated-phase, metalclad bus connects the two generators of each unit. Extensions connect the unit to two of the transformer banks, one bank connecting to each 69-kv system. Tie between generators permits equal division of total generator output between systems. It also holds the two generators in step when starting as a compound unit. No circuit breakers separate generators and transformers.

Each generator has a motor-driven exciter. A third exciter is a reserve for either generator of a unit. Automatic control of generator excitation performs two functions. For normal operation,

(*Continued on page* 196)



GAS TURBINES—only recently put to industrial use—are proving highly efficient. Socony-Vacuum aided in their development—lubricates the first gas-fired and first coal-fired turbines placed in operation.



HYDRAULIC GIANTS—of type shown—have rotating parts with combined weight and thrust of 250 tons! Microscopically thin films of a famous Gargoyle oil protect these vital parts against damage and wear!

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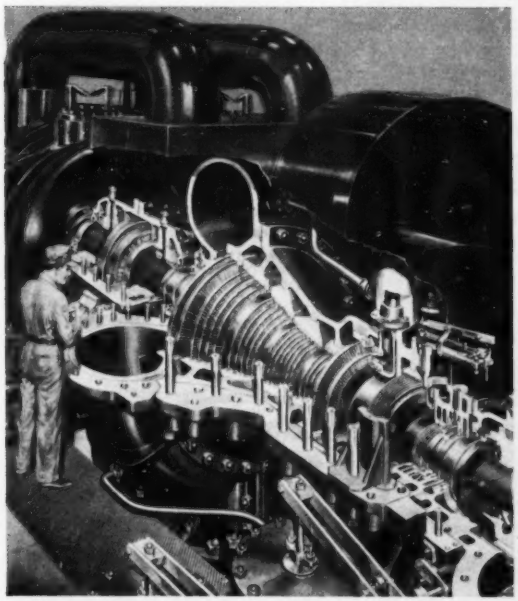
with the Biggest, the Most, the Latest!



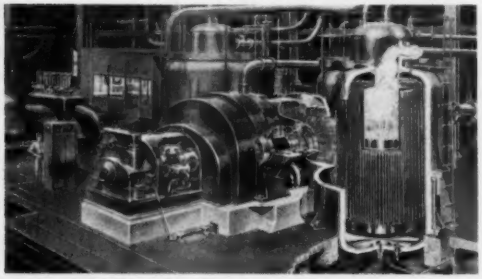
STEAM TURBINES—from the smallest to the world's biggest—are charged with famous Gargoyle oils. In fact, more turbines of 5,000 KW and over are lubricated by Socony-Vacuum than by any other oil company!

Why Accept Anything Less?

Among the many claims made for various turbine oils, one *fact* stands out . . . more turbines of 5,000 KW or larger are lubricated by Socony-Vacuum than by any other oil company! Here's why—

Famous Gargoyle D.T.E. oils are top quality—backed by 85 years of lubrication experience. They protect fully over unusually long periods, give extra long service life, help turbines run more continuously with less need for maintenance.

Why accept anything less for *your* turbines?



MERCURY-STEAM POWER PLANT—first ever designed and coordinated as a unit station—combines two 7,500-KW mercury turbines with a 25,000-KW steam turbine. The entire unit is 100% Gargoyle-lubricated!

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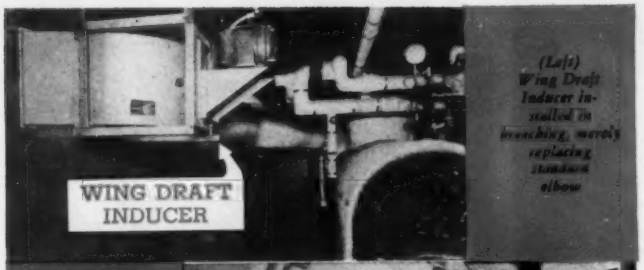
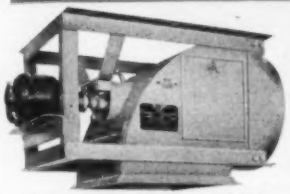


(Left) Wing Draft Inducer installed in breeching, merely replacing standard elbow

(Right) Wing Draft Inducer installed in elbow of breeching operating automatically with oil burner

How to Insure Positive Draft



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The Wing Draft Inducer provides a means for furnishing positive, uniform, adequate draft for low pressure heating plants without the need for tall, unsightly, expensive stacks.

It permits operating at high efficiencies without regard to weather conditions. Thorough and efficient combustion with high CO_2 content is assured. Smoke, gas and explosion hazards are reduced or eliminated.

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Factories: Linden, N. J. and Montreal, Canada

Wing

DRAFT INDUCERS

EQUIPMENT NEWS

(*Continued from page* 164)

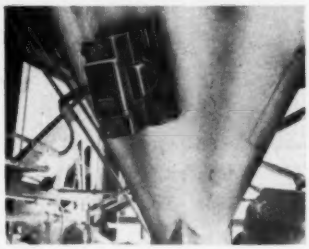
For more data on these items, use post cards, p166a. Identify request with P and number.

MOTOR STARTER **P439**

Protection of operating personnel as well as the connected machine is stressed in the *Motor Watchman*, Class 10-100-S1. With ratings up to 600-v, 7½-hp polyphase, 5-hp single phase; or 220-v, 1½-hp dc, it starts, stops, and provides overload protection for single-phase, polyphase and dc motors.

The self-indicating handle, interlocked cover that prevents opening unless starter is "off," and safety latch to lock starter "off" during servicing are all personnel-protection features. Positive motor-protection is provided by the quick-make, quick-break, over-center toggle mechanism —*De-ion* arc-quenching — and bimetallic disk-type thermal overload relay.

Westinghouse Electric Corp, PO Box 2099, Pittsburgh 30, Pa.



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Semi-noiseless vibrators for bin, hopper and chute perform the same function as the standard models, with a sharp reduction in the operating noise. They are especially useful on interior bins, hoppers and chutes where large numbers of employes are working.

Units are available in four models, with capacities ranging for use on small hoppers

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CHAPMAN STEEL VALVES have the high precision ratings of custom-made valves — but the economy of production-line manufacture.

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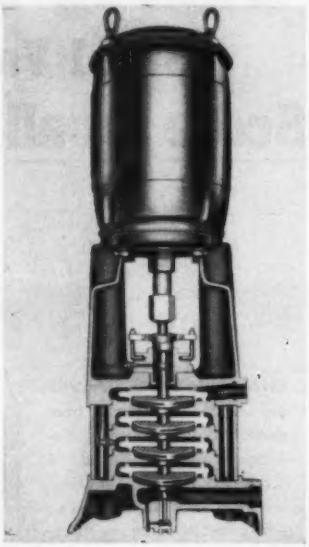
containing as little as 20 cubic feet of material to bunkers holding hundreds of tons for operation from 110- or 220-v ac. **Syntron Co, 492 Lexington Ave, Homer City, Pa.**

For more data on these items, use post cards, p166a. Identify request with P and number.



HIGH-PRESSURE PUMP P421

This vertical multistage high-pressure centrifugal pump requires small floor space. It has wide application in general industrial use where the liquids are noncorrosive to iron and bronze. Can also be used for boiler-feed service where temperatures do not exceed 250 F.

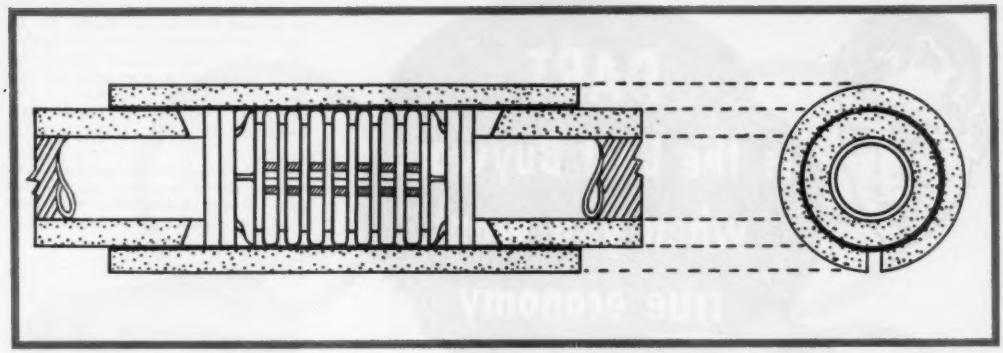
Pumps are built in 2, 3, 4, and 5 stages with 1½-in. suction and 1-in. discharge. Each stage is a separate section. All stages are held together by through bolts outside of water passages.

Pump and motor are built together as unit. Motor bearing is ample size to carry the small thrust load of pump. Stainless-steel pump shaft couples to motor with compression-sleeve coupling. When specified, a mechanical seal can be had in place of stuffing-box packing. Capacities range from 10 to 45 gpm against heads up to 400 ft, with 2-, 3-, and 5-hp motors operating at 3500 rpm.

The Deming Company, Salem, Ohio.

EVAPORATOR PURIFIER P404

Line of evaporator purifiers, the *Upflow*, for use inside industrial evaporators and other large tanks, is designed to remove entrainment from vapors. Efficiency is said to be extremely high, pressure drop negligible, even at vapor velocities above 25,000 fpm. Units are made in three models. The first, Type ASD, is a one-piece unit for installation in evaporators with large outlet nozzles. Second model, ASD-1, is made in five parts for easy installation through



We have been asked:

How would you insulate an expansion joint on an outdoor steam line?

"When our outdoor steam line was originally insulated," writes the power engineer of an eastern manufacturing plant, "we boxed in the accordion-type expansion joints with blocks of insulation. Today the boxes are badly broken from movement during expansion and contraction of the line, and we want to reinsulate the joints to keep out the weather and keep heat losses down. Can you suggest a more efficient way of doing this?"

Here's our answer:

The curved casing method, illustrated above, has proved to be an excellent way of insulating accordion-type expansion joints. It's simple and quick. A piece of sheet metal is curved around the expansion joint with a bearing on the flanges and extending beyond them for 4" to 6". A small opening should be left in the bottom of the metal to bleed off condensation. Then the sheet metal, with the exception of the opening, is covered with blocks of insulation the same thickness as that on the adjacent line. Blocks are scored and bent to fit the curve then wired in place and weatherproofed. The sheet metal sleeve allows for movement of the joint without buckling, crushing, or splitting the insulation around it that occurs when the boxed-in method is used.

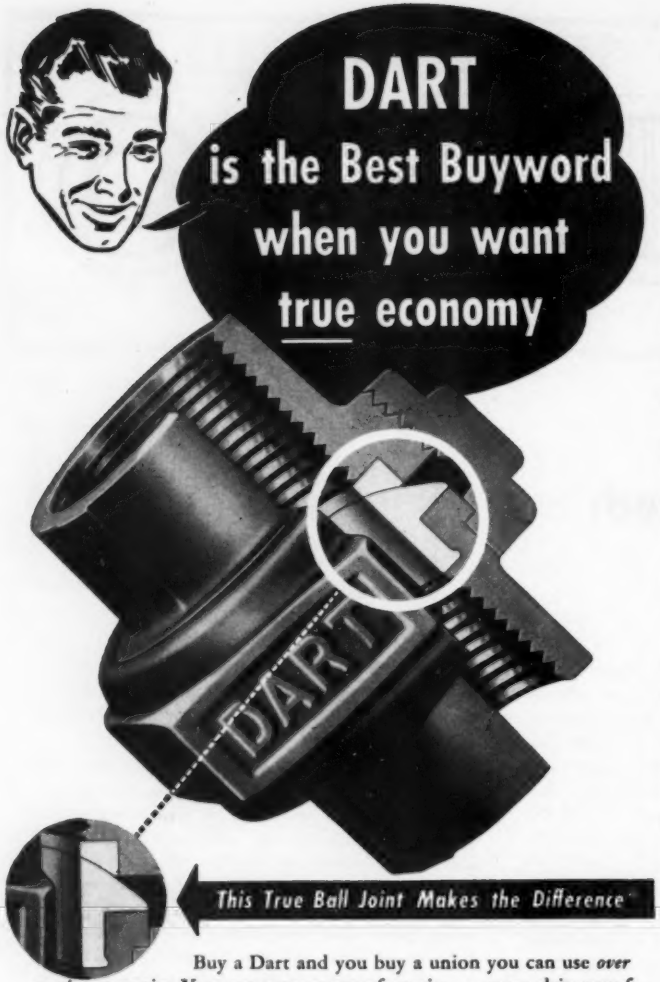
Helping select the best method of insulating any joint, line, or piece of heated equipment is just one phase of the operation of Armstrong's Contracting Organization. In addition to engineering advice, the insulation service offered by Armstrong includes a complete line of good insulating materials and the services of expert mechanics to apply them. The next time you have insulation work to be done, call the Armstrong engineer in the office nearest you. His advice during the planning stages may save you money and at the same time give you a more efficient installation.

IF YOU HAVE ANY QUESTIONS involving industrial insulations for low- or high-temperature applications, we'll do our best to help you solve them. Just address a letter or post card to Armstrong Cork Company, 7004 Maple Avenue, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS - INSTALLATION

FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2800°F.



Buy a Dart and you buy a union you can use *over and over* again. You get *more* years of service — more drip-proof installations — *more* for your money.

Why do Darts last longer? Primarily because they're built heavier —*better.* Seats, for instance, are spherically ground to a *true* ball joint. Thus, a Dart tightens easily—stays tight. Seats remain unmarred—true and clean for the next installation.

What's more, practically indestructible, air-refined malleable iron is used for body and nut—bronze for both seats. There's maximum protection on the outside against rough usage—maximum protection inside against corrosion and pitting.

No question about it, Dart is a *better* buy.

DART UNION COMPANY
Providence 5, Rhode Island
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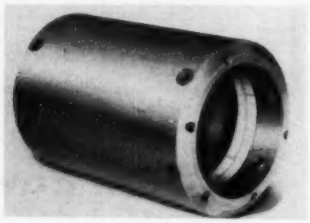
DART
UNIONS

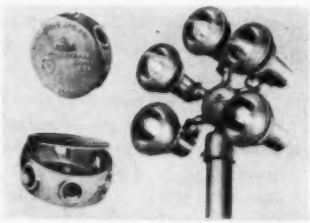
a large manway. The last model, ASD-2, an 11-piece assembly, is divided into this many small parts so it can go in chambers where access may be made only through small outlet nozzles or cramped manways. Sizes range from 12 to 36 in.
Centrifix Corp, 3566 Payne Ave., Cleveland, Ohio.

For more data on these items, use post cards, p166a. Identify request with P and number.



PIPELINE COUPLING **P417**

Coupling for quick joining of crude oil, gasoline and gas pipelines permits sealing of pipes from 2 to 6 in. in diameter. Full pipeline pressure can be restored immediately and welding done after line is back in service. Because of the mechanical seal with neoprene rings, coupling makes it possible to join high-pressure steel pipelines under hazardous conditions without using a torch. Couplings are designed to withstand 1200 psi indefinitely when set manually, and much higher pressures after welding.
E H Wachs Co, 1526 N. Dayton St, Chicago 22, Ill.

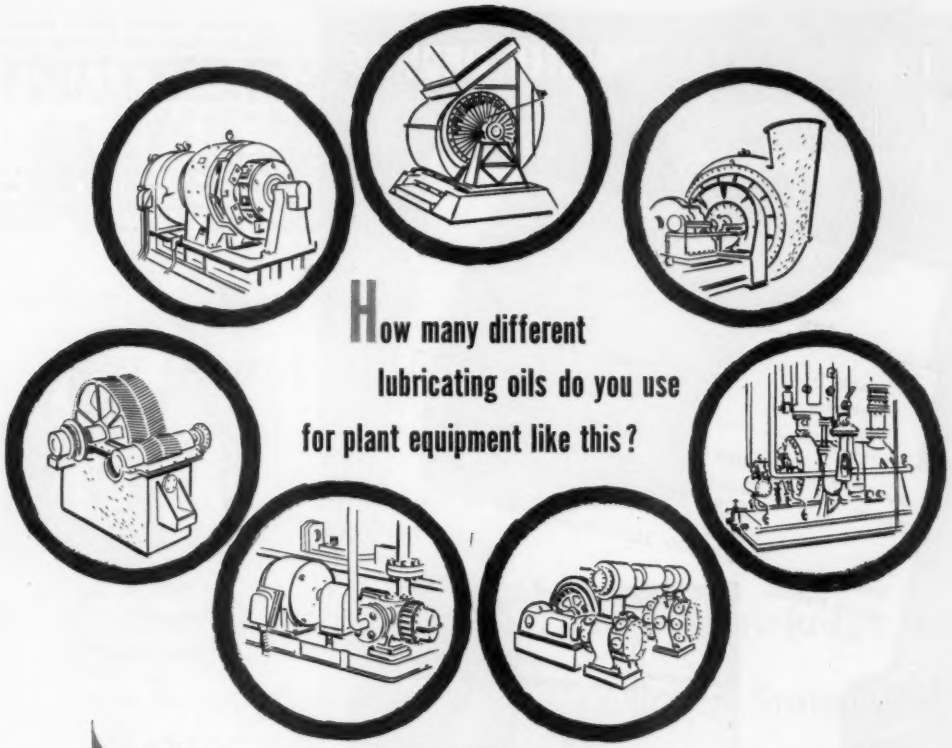


OUTDOOR FLOODLIGHTS **P435**

Weatherproof Cluster Box No. 25 lights for outdoor protective lighting. Designed to conserve critical aluminum, the new unit combines tough aluminum alloys that are precision die-cast. A removable cast-aluminum cover plate sealed with a heavy cork gasket provides easy access to inside wiring. Each box has six ½-in. tapped holes to take from one to five standard lampholders for the 150-watt, 200-watt and 300-watt outdoor weatherproof reflector bulbs available as standard stock from all major lamp-bulb manufacturers.
Stone Manufacturing Co., 489 Henry St, Elizabeth 4, N. J.

INSULATING BUSHING **P441**

Ribbed outer surface of bushing facilitates installation by providing a sure grip. Ribs may also be used as a driving point



How many different lubricating oils do you use for plant equipment like this?

You need only one—

GULF HARMONY OIL

the outstanding many-purpose lubricant

for: Motors and Generators · Fans · Blowers · Pumps · Compressors · Hydraulic Mechanisms · Gear Units

Gulf Harmony Oil is a top quality many-purpose lubricating oil, ideal for sleeve-type bearings, oil-lubricated ball and roller bearings, hydraulic systems, compressor cylinders, and many types of gears.

Because of outstanding oxidation stability, Gulf Harmony Oil has exceptional resistance to sludging. In force-feed circulating systems, oil reservoirs, hydraulic lines, and antifriction bearings, the use of Gulf Harmony Oil helps prevent harmful deposits, insures fewer oil changes.

Gulf Harmony Oil provides a protective film which has preferential wetting characteristics for metal—it displaces moisture, interrupts its corrosive action. Thus Gulf Harmony Oil prevents rust on all oil-bathed surfaces—particularly important in antifriction bearings operating under damp conditions. And it separates readily from water, reducing the possibility of emulsification.

Its high lubricating value means more effective protection against wear under boundary conditions. Available in a wide range of viscosities.

For complete information on Gulf Harmony Oil and for expert help on any lubrication problem, call in a Gulf Lubrication Engineer today. Gulf Oil Corporation · Gulf Refining Company, Gulf Building, Pittsburgh 30, Pennsylvania.

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PETROLEUM AND ITS PRODUCTS

JUST WHAT THE ENGINEER ORDERED

For compact, efficient steam production

CHARGE TO: PETER PAUL, INC.
SHIP TO: Naugatuck, Conn.
TYPE: B

CHARGE TO: BELCHERTOWN STATE SCHOOL
SHIP TO: Belchertown, Mass.
TYPE: B

CHARGE TO: AMERICAN CYANAMID COMPANY
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TYPE: B
STEAM RATING: 20,000 lbs. steam per hr.
DESIGN PRESSURE: 160 lbs.

TYPE B DESIGN FEATURES

- Factory fabricated boilers require minimum field work.
- In many cases, sizes up to 330 HP can be shipped completely assembled.
- Water tubes along furnace side walls reduce maintenance costs.
- Furnace design provides high efficiency with any method of firing.
- Extremely low head room. Maximum capacity for floor area.
- Can be operated at high overloads without disturbing water level.

Write for free catalog on the Type B or on any of the units listed below.

BOILERS BY BIGELOW

Water Tube Boilers — Bent Tube Types
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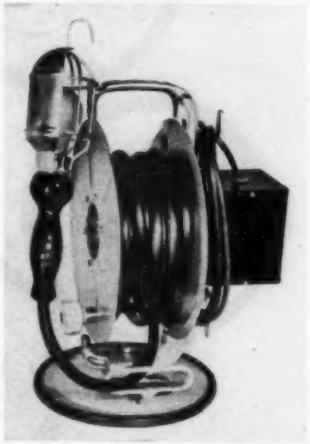
BI-4

for tapping bushing with a screwdriver. This male thread bushing may be used with either a lock nut or OZ type-A insulating bushing.

O Z Electrical Mfg Co, 262 Bond St, Brooklyn, N. Y.

For more data on these items, use post cards, p166a. Identify request with P and number.



LOW-VOLTAGE LAMPS **P475**

Saf-T-Lite is becoming increasingly important in helping reduce industrial casualties due to electrical shock. In many industrial plants, public utilities, railroads, hotels, etc, it is now standard equipment, having replaced the old 110-v trouble lamp. *The Reel-Lite* unit employs a well-known reel for holding the extension cord. It is available in several different sizes with extension cords of 50 and 100 ft.

Etraco Manufacturing Co, Inc, Woods Church Road, Flemington, N. J.

GREASE-PUMP KIT **P434**

A *Lubrikit* for reloading individual bearings and centralized lubricating systems. Unit consists of an electrically operated barrel pump, mounted on a 400-lb grease

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Controlled Quality

PIPE FITTINGS

...When you judge by Operating Statements

Maximum strength and endurance to minimize shutdown losses and replacement costs... these are important operating economies you can trace directly to the laboratory safeguards of Ladish Controlled Quality. Advanced metallurgical controls over materials and forging methods assure complete dependability in every Ladish fitting.

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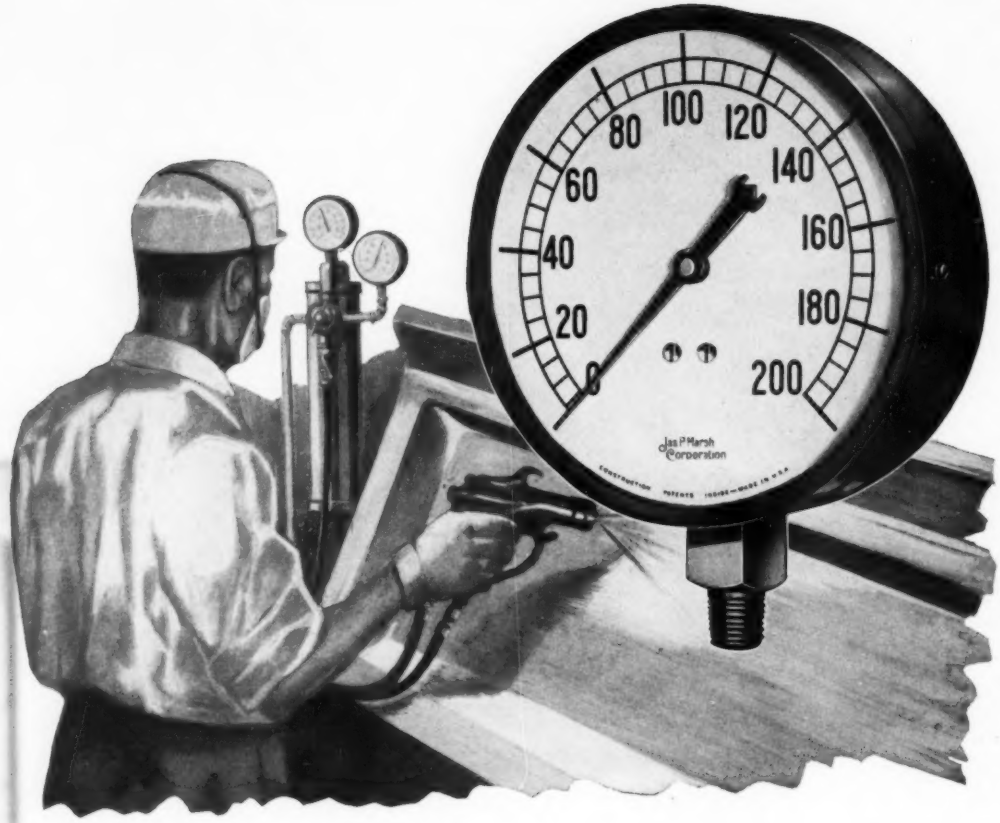

His work is no better than the Pressure Gauge

Good paint spraying depends, not only on the equipment, or the skill of the operator, but equally on the pressure behind the gun. Whether the pressure is too high, or too low, or too uneven, or just right, only a pressure gauge can tell. If the gauge is wrong, the operator will be wrong, and so will the end results.

To entrust such important results to any but the best pressure gauges is obviously penny-wise practice. But because pressure gauges are such a familiar part of so many plant processes, it is easy to overlook the vital role they play in the efficiency and safety of all pressure equipment operation. Do not make this mistake. Remember that accuracy is meaningless unless it is lasting accuracy, and that it takes the kind of experience Jas. P. Marsh has had, the kind of facilities Marsh has developed, to build gauges of truly lasting accuracy.

Manufacturers of quality pressure equipment recognize this. A distinguished instrument, Marsh keeps distinguished company. Take the leading manufacturers in any field—boilers, hydraulic presses, compressors, food equipment, testing apparatus—and see what gauge they use on their equipment. In nearly every case you will find that Marsh is the gauge.

Make this your final reason for insisting on Marsh Gauges throughout your plant.

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Export Dept., 155 E. 44th St., New York, N. Y.

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GENERATING STATIONS

STATION P 360,000 HORSEPOWER

The Ohio Injector Company is proud that OIC Valves are having a share in Pacific Gas & Electric Company's mammoth expansion program to bring more power to Northern and Central California. It is a compliment to the quality of our product.

You can specify OIC Valves for any valving requirement and be assured of efficient, precise control. That's because OIC Valves are *precision engineered* and *precision built. Precision application* know-how of OIC engineers is available to help you select valves best suited to each requirement.

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drum for filling grease reservoirs, a hand transfer pump on a 100-lb drum for delivery of oil, and a tool box containing hand tools, miscellaneous fittings and hand guns for servicing individual bearings.

Necessary hose, nozzles and gages are included—all mounted on a steel base 30x60 in., and 10-in.-diameter rubber casters. Casters have two solid and two swivel for easy maneuvering through factory aisles.
J N Fauver Co, Inc, 49 West Hancock, Detroit 1, Mich.

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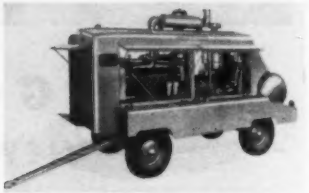
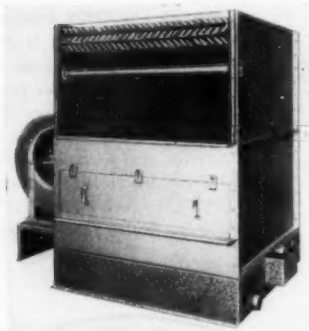


PORTABLE AIR COMPRESSOR P414

Large-size unit has rotary-type compressor. Designated as *Gyro-Flow 600*, it delivers 600 cfm free air at 100 psi. Weight, ready for use, is 9500 lb. Compressor is 2-stage, oil-cooled, rotating-vane unit. It eliminates pistons, connecting rods, valves and need for a clutch. Air discharged at less than 200 F under normal operating conditions. Unit is driven by General Motors series 71 diesel engine. This is a 6-cyl, 2-cycle engine with 12-v battery starting and a fast-starting ether system for cold-weather operation. Variable intake unloading of compressor and floating-speed control of engine hold pressure fluctuation to within 10 lb in full-load range from 0 to 100%. Fuel tanks have capacity for eight hours' operation.
Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.



COOLING TOWER P409

New and improved *Dry-Fan* cooling tower, blower type, comes in two models. The 2-B is a single-fan model available in nine sizes ranging in capacity from 3 to 30 tons of refrigeration. Smallest tower is 2x2x6 ft, the largest 6x6x7 ft, 6 in. The

400° F.

350° F.

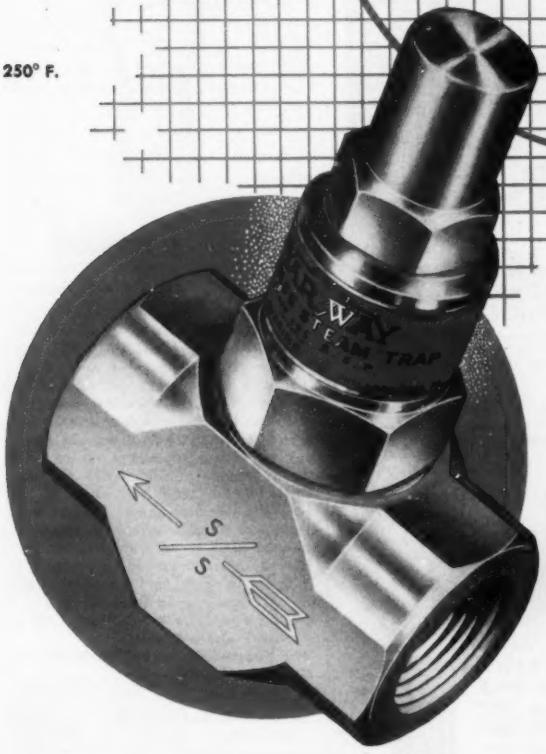
300° F.

250° F.

FOR EVEN TEMPERATURES

YARWAY

STEAM TRAPS



● Processes requiring careful temperature control call for Yarway Impulse Steam Traps on steam equipment.

The reason . . . Yarway traps maintain even temperatures because they *continually* sample and respond to a trickle of the condensate. There is no arrest in flow, no waiting for large quantities of condensate to accumulate, or trapped steam pockets to condense.

Other reasons why Yarway Impulse Traps have become first choice in many thousands of plants:

- **They get equipment hotter, sooner**
- **Small size, light weight**
- **Easy to install, easy to maintain**
- **Only one moving part**
- **Good for all pressures**
- **Stainless steel construction**
- **Low cost**

If you are not already familiar with these and other advantages of the Yarway Impulse Steam Trap, try one *for free* and find out for yourself. Call your nearby Yarway distributor, or write to:

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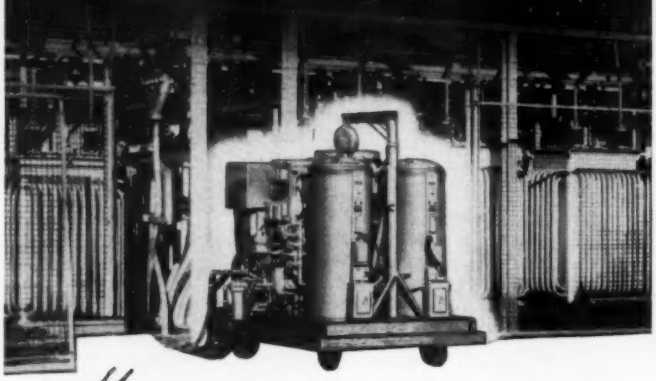
Stainless Steel Body

YARWAY IMPULSE STEAM TRAP

Eliminate SHUT-DOWNS and EXPENSIVE REPAIRS

on Transformers, Turbines and Diesel Engines

with HONAN-CRANE Oil Purification Equipment



Many leading utilities such as Detroit Edison, Ohio Public Service Co., Pennsylvania Power, etc., have standardized on Honan-Crane oil purification equipment for removal of damaging contamination from insulating, Turbine and Diesel oils.

Honan-Crane can give you exact equipment to do the job. Equipment that will remove all types of oil contamination.

In every installation Honan-Crane equipment quickly pays for itself out of savings in oil and maintenance costs.

● Write today for Honan-Crane Bulletins: "Purification of Insulating Oils", "Purification of Turbine Oils".

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Houdaille Purivac (Shown Above)

A complete automatic system for purifying, dehydrating and degasifying insulating oil in the field or at a central location. For large volume purification requirements.

Honan-Crane "R" Type Purifier

Mobile oil reconditioning unit for centralized batch purification. Ideal for volumes of oil requiring capacities up to 200 G.P.H.

FOR TURBINE AND DIESEL OILS

Honan-Crane "M" Type Purifier (Right)

"Continuous" type purifier removes solid contamination as well as products of oxidation (acids, asphaltenes, gums and resins). Keeps neut. number and steam emulsion number within desired limits. Sizes to fit all needs.

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HONAN-CRANE CORPORATION

1200 SIXTH ST., LEBANON, INDIANA

a subsidiary of

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2-BB series have two double-inlet squirrel-cage blowers and come in four sizes ranging in capacity from 32 to 60 tons of refrigeration. Towers are from 4 ft, 6 in.x9 ft x7 ft 6 in., to 6 ft 6 in.x11 ftx7 ft, 6 in. Copies of *Bulletins 46* and *47* describe these new towers fully.

Binks Mfg Co, 3122 Carroll Ave, Chicago 12, Ill.

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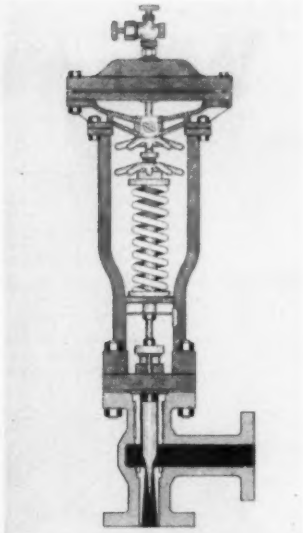


FLOW-REGULATING VALVES P413

Type V10 flow-regulating valves are designed to handle steam and water at high pressure drops, and especially flashing condensate. Uses include drainage for stage heaters, evaporator coils, flash tanks, process systems, subcooled heaters, boiler blowdown, feed-pump recirculation and other severe service conditions where high-velocity impingement causes frequent maintenance or complete valve replacement. All internal parts of valve are stainless steel, heat treated and ground to precision fit. Supplied in seven pipe sizes from 1 to 4 in. All sizes can be furnished in 150 to 600 psi standards; 900-1500 and 2500 psi standards also available.

The Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio.

SELENIUM RECTIFIER P438

High-voltage cartridges with voltage ratings up to 25,000 v per cartridge and current ratings up to 75 ma have been recently developed. These rectifier cartridges utilize five different selenium cell sizes varying from ⅛- to 1-in. diameter, with corresponding current ratings varying from 1.5 ma up to 75 ma.

They are designed to meet rigid humidity, altitude-vibration and shock specifications, and they can be operated over the temperature range of –55 C to 100 C. These

Built like an auto, Yale "Lift King" has TIMKEN® bearings of course!

THE Yale "Lift King" gasoline truck shown here uses several proved automotive design features for better performance. Fluid drive, heavy duty hypoid gearing, auto-type controls, brakes and steering mechanism—and Timken® tapered roller bearings, first choice of the automotive industry.

The "Lift King" has Timken bearings in the pinion, differential, steering wheels and drive wheels. Timken tapered roller bearings keep the shafts in precise alignment, the gears in close mesh. Wear on parts is reduced. The machine lasts longer and replacements are fewer. Bearing maintenance costs are reduced, too.

The tapered design of Timken bearings enables them to carry radial, thrust and combination loads. Line contact between rollers and races gives them the capacity for the toughest loads. Their true rolling motion and amazingly smooth surfaces virtually eliminate friction. And Timken bearings normally last the life of the machine because they are engineered for the job, made of Timken alloy steels, and precision manufactured.

No matter what kind of machines you make or use, always make sure the bearings are the best. Look for the trade-mark "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

How **YALE & TOWNE MANUFACTURING COMPANY** *mounts lift truck pinion shaft on Timken bearings for smooth operation, low-cost maintenance and long life.*

FINISHED TO CLOSER TOLERANCES

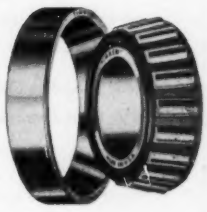
Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE-MARK REG. U.S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ◯ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◐ AND THRUST ←◐→ LOADS OR ANY COMBINATION ←✳→

How to look at 500 lbs. of steam *safely*

Safeguard your eyes from scalding steam and flying glass. Watch your water level safely through SONDERGLASS, the safe gauge glass. Virtually two tubes in one . . . the outer hardened to resist cold drafts and erosion . . . the inner to withstand great heat.

Sonderglass has been dipped into 450°F oil and repeatedly plunged into cold water without spalling or cracking.

Today, equip your boilers with the safe glass — Sonderglass — and enjoy the satisfaction of knowing that you have the best.

SONDERGLASS

THE SAFE GAUGE GLASS

PACKING Chesterton SERVICE

A. W. CHESTERTON CO.
6 Ashland St., Everett 49, Mass.

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☐ Who is my distributor?

Name_____ Company_____

Street_____

City_____ State_____

cartridges are available in prenolic tubings with either pigtail or ferrule-type terminals.

International Rectifier Corp, 6809 South Victoria Ave, Los Angeles 43, Calif.

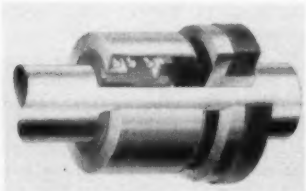
For more data on these items, use post cards, p166a. Identify request with P and number.

AUTO TRANSFORMERS P432

These transformers are wound 3-phase open delta with taps at 50%, 65%, 80% and 100% of line voltage. They conform to NEMA standards for medium duty.

Standard types are available from 5 to 200 hp, in both 220 and 440 volts, 50/60 cycles. Special voltages as well as 2-phase units and other frequencies can also be obtained.

Etraco Mfg Co Inc, Woods Church Rd, Flemington, N. J.



MECHANICAL SEALS P420

Where leakless operation of a rotary shaft on a pump or other equipment is required, a good mechanical seal will do the job. Sealing is obtained by positive contact between carefully lapped metal-to-carbon or metal-to-metal mating surfaces. One of these elements rotates with the shaft and the other is stationary. The stationary element does not contact the shaft so one does not wear the other.

These seals are made in several standard designs and in a wide range of materials. Design and materials depend on service the seal is to be used in. Descriptive booklet.

Garlock Packing Co, Palmyra, N. Y.

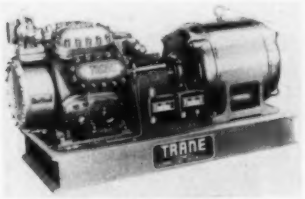
INDUCTION REGULATOR P451

Line of 3-phase, dry-type, induction voltage regulators for regulated 3-phase power at low voltages. New line includes both self-cooled and forced-air-cooled regula-

tors in standard 10 and 20% (raise and lower) ranges of regulation.

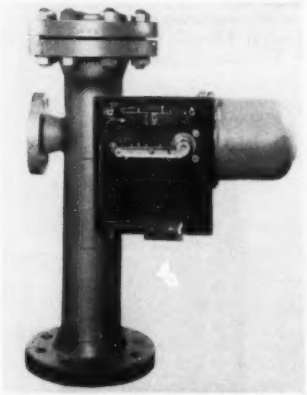
Standard line is being offered in ratings from 120 to 600 v and from 12 to 85 kva. Three-phase, dry-type ratings have been available in these sizes in the *Triplex* assembly, which consists essentially of three single-phase regulators on a single base. **General Electric Co, Schenectady 5, N. Y.**

For more data on these items, use post cards, p166a. Identify request with P and number.



RECIPROCATING COMPRESSOR P429

Quiet, vibrationfree operation, low maintenance and operating costs are promised with the new 10, 15, 20, 25, 40 and 50 ton reciprocating compressors recently put on the market. Body design is cylindrical; compressor cylinders are mounted in *V* and *W* arrangements for the 4-, 6- and 8-cylinder models; all reciprocating forces are counterbalanced; crankshafts are dynamically and statistically balanced. Noise level is said to be 2 to 10 decibels (db) below other compressors.
Trane Co, La Crosse, Wis.



LIQUID-LEVEL DETECTOR P406

Precise, sensitive, liquid-level control, superior to either a differential-type meter such as a mercury manometer or a torque tube displacer serves, according to the manufacturer, those applications considered beyond the capabilities of differential or torque tube displacer transmitters. The new displacement detector and transmitter uses a bellow seal to insure sensitivity.

Two bellows-assemblies mount above a set of levers (*photo above*) which transmit

A WONDERFUL NEW PRODUCT THAT COMPLETELY

ENDS BELT SLIPPAGE

AN ENTIRELY NEW CONCEPT IN BELT DRESSING

Chesterton Belt-Flo is a new liquid belt dressing that contains neither rosin nor asphalt. It will not pick up dust or dirt. It will increase transmitted horsepower up to 50%! It never builds up on belts.

"Belt-Flo" holds its power because it does not harden. Is applied to running belts through applicator spout. Colorless — Nontoxic.

"Belt-Flo" ideal for use on Leather, Rubber or V Belts.

Carried by all leading Industrial Supply Jobbers. Order today and experience an entirely new concept in belt dressing that ends belt slippage . . . for ever!

Chesterton Belt-Flo

PACKING Chesterton SERVICE

A. W. CHESTERTON CO.
6 Ashland St., Everett 49, Mass.

☐ Without obligation, have my local distributor call and demonstrate Belt-Flo.

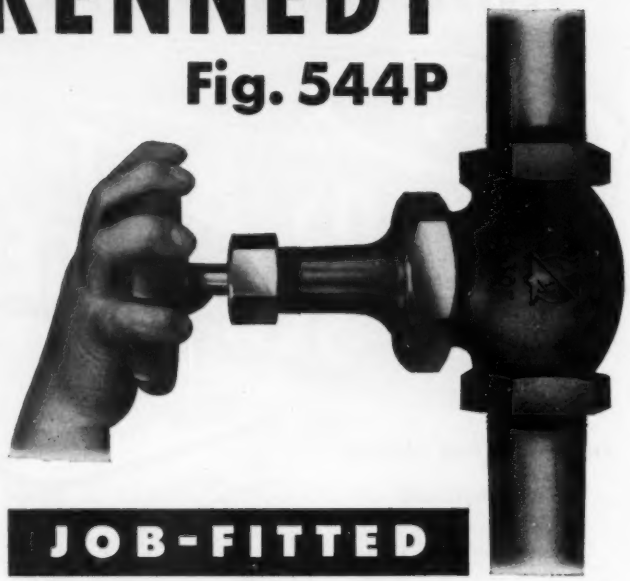
Name_____ Company_____

Street_____

City_____ State_____

KENNEDY

Fig. 544P



JOB-FITTED

for longer disc and seat life... where accurate control is a must

Like all valves in the complete KENNEDY line these bronze globe valves are JOB-FITTED . . . specially designed and engineered for the job they have to do!

UNION BONNET RING, heavy bronze section with extra thread engagement to assure a tight joint. Union bonnet makes a valve easy to dismantle and reassemble.

STEM, Naval Brass Rod, Acme threads, large diameter with extra thread contact . . . extremely resistant to wear.

PACKING, molded rings of graphited, wire-inserted asbestos designed for high pressure service.

PLUG TYPE DISC, nickel copper alloy, has extra wide seating surfaces for precise throttling control . . . is exceptionally resistant to scouring or wire drawing.

RENEWABLE SEAT RING, nickel copper alloy, ground to match disc in each valve to assure full bearing surfaces over entire contact area of each.

KENNEDY Fig. 544P, plug type disc, and Fig. 544, full-way disc, are designed for 300 lbs. steam, 600 lbs. WOG. Fig. 138P, plug type, and Fig. 138, full-way disc, for 200 lbs. steam, 400 lbs. WOG.

WRITE FOR BULLETIN 108

THE **KENNEDY**
VALVE MFG. CO. • ELMIRA, N.Y.
Est. 1877

VALVES • PIPE FITTINGS • FIRE HYDRANTS

movement to the balancing bellows. The bellows movement opens the supply-air port, permitting air to enter the bellows. This air pressure continues to increase until enough force is created to bring all components of the system back to their original position before any change in level took place.

Brown Industrial Div, Minneapolis-Honeywell Regulator Co, Wayne & Roberts Ave, Philadelphia 44, Pa.

For more data on these items, use post cards, p166a. Identify request with P and number.

SYNCHRONOUS GENERATORS P453

Line of *Tri-Clad* high-speed synchronous generators are extended down through 1.875 kva. This now makes available a complete line of generators in *Tri-Clad* construction from 1.875 to 1250 kva. New machines added to the line come in four basic designs, which have ratings from 1.875 to 50 kva.

Designated as Types ATI, ASI and ATB, the generators have frequency ratings of 60 and 400 cycles. Three standard types of 60-cycle generators are offered, providing a range of characteristics for several categories of voltage-regulation and motor-starting requirements.

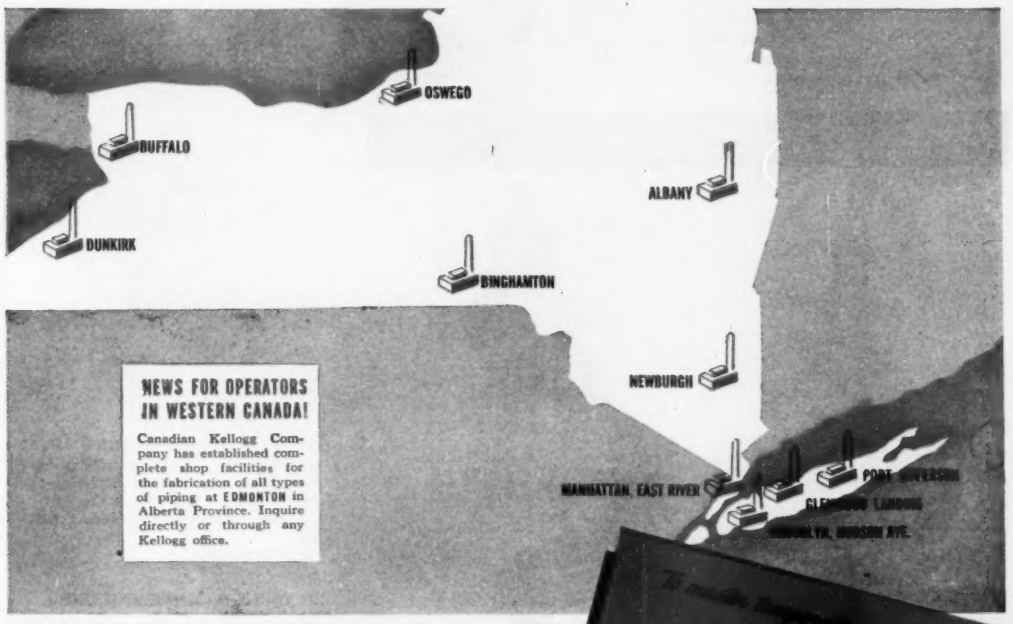
General Electric Co, Schenectady 5, N. Y.

OSCILLOSCOPE P446

Model 476 *Mirroscope* is designed to save space on the test bench. The 5-in. cathode-ray tube is mounted in a vertical position.

Note: Over 1,250,000 kws for New York State alone!

...within a very short space of time, we have contracted to fabricate the major power piping for over 1,250,000 kws. of additional steam power capacity for New York State alone. Most of these orders include job-site installations as well. All piping is for modern high-pressure, high-temperature systems — predominantly of the reheat type — with operating temperatures of 1000°F. or higher. When completed these new power installations will expand the state's total steam-generated capacity by well over 20%.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NEWS FOR OPERATORS IN WESTERN CANADA!
Canadian Kellogg Company has established complete shop facilities for the fabrication of all types of piping at EDMONTON in Alberta Province. Inquire directly or through any Kellogg office.

Special studies of unusual problems such as graphitization to assure long life and low maintenance.

Metallurgical research by recognized specialists who have made major contributions in this field.

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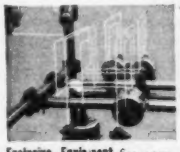
To make temperatures, pressures and chemicals do useful work

M. W. KELLOGG

Pioneers and pacesetters in process engineering



Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

Top welding performance in shops and in the field by welders accustomed to working under X-Ray checks.

Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

Pressure Vessels
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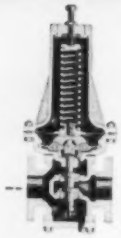
STEP UP YOUR PROCESSING EFFICIENCY BY CLOSER REGULATION OF EXCESS PRESSURES

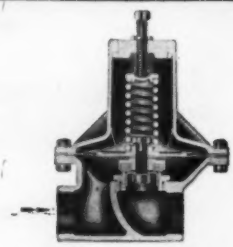
The Foster line of Automatic Pressure Relief Valves has been developed to provide the close regulation of excess pressures necessary for efficient processing. They protect the equipment from damage due to overpressure without loss of fluids in process in closed systems.

Each type has been designed to meet specific service conditions, and is built of materials best suited to the process. That's why they do their jobs better, and require less maintenance.

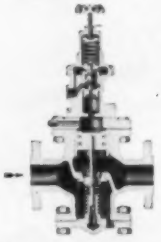
Here are 4 typical Relief Valves in the Foster line of more than 20 standard types:



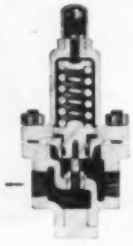
(FOSTER R-1)
The Foster Type R-1 is especially suitable for steam, oil and heavy liquids. Direct acting, diaphragm actuated for sensitive regulation.



(FOSTER R-3)
The Foster Type R-3 is built for general service on normally low pressures. Direct acting, with large diaphragm area for quick response to small changes in pressure.



(FOSTER R-4)
The Foster Type R-4 is designed primarily for high pressure steam service where practically instantaneous relief is required with minimum build-up. Internal pilot-operated.



(FOSTER R-22)
The Foster Type R-22 is used to relieve high pressures in hydraulic systems where extremely close regulation is not a requirement. Direct acting, piston actuated.

FOSTER ENGINEERING

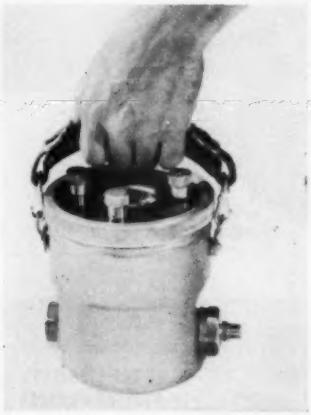
PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . CUSHION CHECK VALVES . . . ALTITUDE VALVES . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN VALVES . . . VACUUM REGULATORS OR BREAKERS . . . STRAINERS . . . SIRENS . . . SAFETY VALVES . . . FLOW TUBES

This construction reduces bench requirements to an area of only 9x8 in.

Cathode-ray image is reflected from a high-grade mirror mounted in the adjustable cover at the top of the cabinet. Thus the viewing surface is brought near the eye level when the instrument is used on benches of normal height.

Simpson Electric Co. 2500 W. Kinzie, Chicago, Ill.

For more data on these items, use post cards, p 166a. Identify request with P and number.



EXPLOSIONPROOF METER P425

Portable, 6-lb, 5½-in.-dia, 6½-in.-high gas-detecting meter permits analyzing gas lines for leaks at any point in the line.

Lor-Ann Instrument Co, Jersey City, N. J.

PORTABLE HAMMER AND DRILL P430

Combination, portable, 15-lb, aluminum-alloy-body power tool, *the Do-All* has arc motor equipped for three jobs: (1) drilling concrete and masonry (2) driving, grinding, buffing (3) drilling metal and wood. *The Do-All* has a universal motor with fan ventilation and a start-stop switch in the handle.

Wodack Electric Tool Corp., 4627 W Huron St, Chicago 44, Ill.

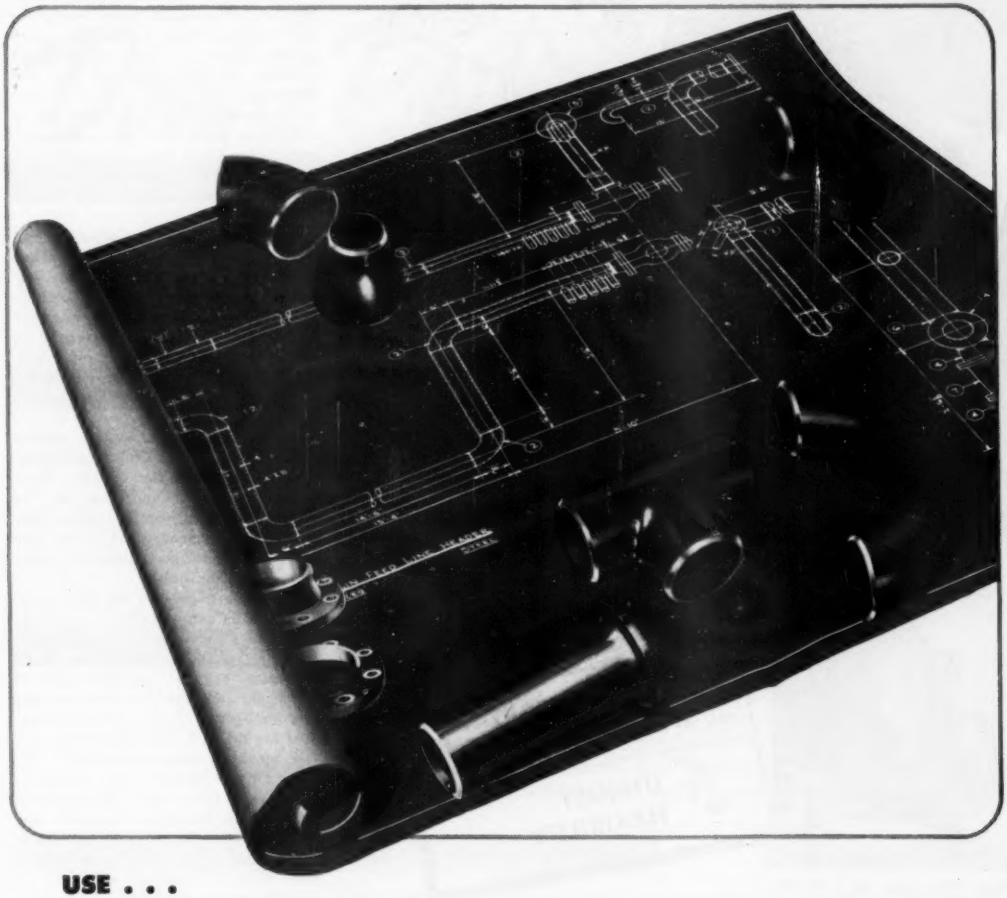
GEARED MOTOR P431

Single-reduction, *Klosed-tite* construction for atmospheres containing nonexplosive dusts, vapors and injurious foreign materials. An external fan forces powerful cooling blasts of air over streamlined case.

Output shaft ratings are the six AGMA speeds starting at 780 rpm down to and including 220 rpm. Unit is totally enclosed and includes labyrinth seals and ball bearings lubricated for life.

Sterling Electric Motors Inc, 5401 Anaheim-Telegraph Rd, Los Angeles 22, Calif.

TO DO A BETTER PIPING JOB . . .



USE . . .

GLOBE PRECISION PROCESS SEAMLESS WELDING FITTINGS

When you specify and use Globe Welding Fittings you have the product of an organization with unusually broad metallurgical experience. Globe's precision-process method of production reaches back to the manufacture of the Globe seamless tubes themselves which are the "raw material" of Globe welding fitting fabrication.

GLOBE STEEL TUBES CO., Milwaukee 4, Wisconsin

Chicago • Minneapolis • Cleveland • Detroit • New York • Philadelphia
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Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe Welding Fittings.

Send for the Globe Welding Fittings Catalog—and look to Globe as a preferred source of supply.

What Other Drive Gives You...

1. SIMPLICITY, LONG LIFE

So simple that it can be serviced by relatively unskilled mechanics... so rugged that it stands abuse that would wreck other drives... so dependable that it is consistently used where unfailing service is imperative — these are typical advantages gained from the Troy steam engine's basic simplicity. Long life, also, stems from this inherent simplicity and ease of maintenance. Year after year, under the most adverse conditions, Troy Steam Engines continue to deliver dependable, low-cost power.

Plus-

2 ACCURATE, FAST SPEED CONTROL

3 BY-PRODUCT POWER

4 HIGH STARTING TORQUE

5 UTMOST FLEXIBILITY

Year after year: Up in the air, out in the open, the Troy Steam Engine continues to drive this kiln in an asphalt paving plant after many years of dependable operation.

Which Do *You* Need?

If your drive needs any or all of these five characteristics, the modern Troy Steam Engine is indicated. Send us your drive requirements and steam conditions, and our engineers will be glad to recommend the right type and size Troy engine to meet your needs.

Send for Bulletin 306

TROY

Troy Engine & Machine Co.

Power Equipment Division

1207 RAILROAD AVENUE • TROY, PENNSYLVANIA

RIDGELAND

(*Continued from page* 174)

pre-selected generator bus potential will be maintained for normal load variations. Automatic minimum-excitation apparatus will insure stable operation with relatively low field currents.

Auxiliary Power. Electrical system supplies all auxiliary power except to one turbine-driven boiler-feed pump and miscellaneous small turbine-driven auxiliary oil pumps. For each unit, two 8000-kva transformers connect directly to the generator leads to supply power at 4160 v. Duplicate transformers connect to the 69-kv bus. Generators normally supply the power, but the 69-kv supply takes over automatically in case of failure.

The 69-kv system supplies general station auxiliary power. One 10,000-kva transformer connects to each ring bus in the transmission terminal. Load divides between these transformers on the 4160-v side with automatic transfer in failure of either source of supply. Auxiliary motors, over 50 hp up to 3500 hp, will operate at 4160 v, smaller motors at 208 v.

The auxiliary power system consists of five 4160-v and ten 208-v substations. One 4160-v substation supplies large station auxiliaries and also the six 4000/208-v substations for station lighting and miscellaneous small power. Two 4160-v and two 208-v substations serve each generating unit.

Transformers feeding the 4160-v system stand in compartments outside the building wall and connect to the switchgear by 3-phase metalclad bus. Each substation has two parallel rows of switchgear connected by a bus crossing over the operating aisle. All switchgear is of the drawout type. The 4160-v circuit breakers mount on wheels. The 208-v circuit breakers and contactors are stacked three high with monorail facilities for handling removable elements. Open troughs carry cables in tunnels and cable rooms under switchroom floors. Filtered air ventilates all switchrooms to minimize maintenance.

TECHNICAL BRIEFS

(*Continued from page* 172)

starting, and smoke density during starting was generally higher than during steady operation. *ASHVE paper. No number.*

MEASUREMENT OF SMOKE, *by A O Beatty, Jr, and J E Deas, Jr. North Carolina State College.* Quantitative measurement of smoke presents a number of almost insoluble problems. The authors divide smoke indicators into three groups, according to the *ASME Power Test Code of 1945.* They are (1) those

ADD UP THE SCORE ON DE LAVAL'S *Double Protection*

2 + 2 = 4

1. REMOVAL OF DIRT, SLUDGE AND WATER

De Laval machines remove both of the impurities that contaminate turbine lubricating oil. Centrifugal force throws all dirt out of the oil and stores it out of harm's way in the bowl; it separates out any water present and continually discharges it. Water once removed cannot recontaminate the oil.

2. CENTRIFUGAL FORCE DOES NOT REMOVE ADDITIVES

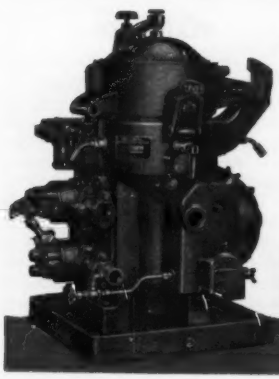
Centrifugal force alone never removes additives. Naturally inhibitors that are soluble in water will be lost with water that is removed from the lubricating oil, whether such removal is effected by centrifugals or filters. Usually very little water is present to be removed, so this cause of inhibitor reduction is inconsequential, but should a major water leak occur in the lubricating system, the centrifuge will promptly remove the water.

3. QUICKER, MORE COMPLETE SEPARATION

De Laval machines multiply the effectiveness of gravity over thousands of times! This means that quicker and more complete separation is possible by centrifugal force than by gravity methods. Moreover, De Laval machines are constant in efficiency. There are no functional parts to lose effectiveness during a run.

4. CENTRIFUGES TAKE CARE OF IMPERFECTIONS

De Laval machines are conservatively rated. They can handle wide variations in water without loss of seal or carry-over into the oil stream.

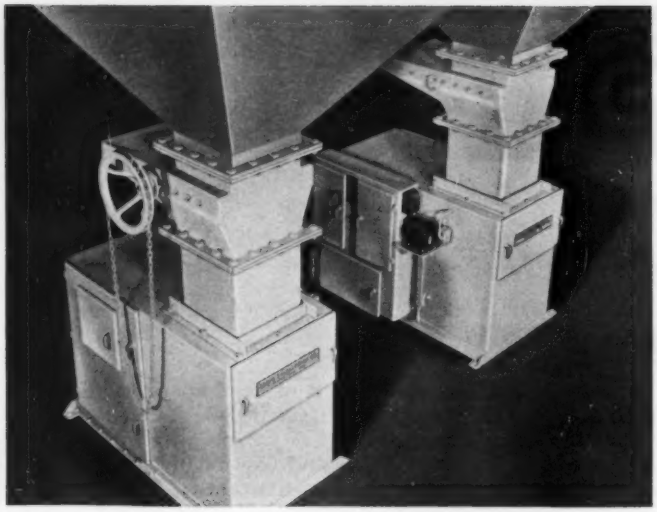


Most Protection per dollar—De Laval's Double Protection for turbines is complete and economical.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL OIL PURIFIERS

for more dependable power production

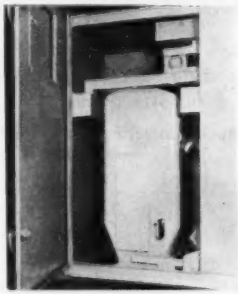


LOW MAINTENANCE COSTS ARE ASSURED

with S-E-CO. COAL SCALES

Large assembly door and feeder access door make it possible to remove the feeder and weigh hopper quickly as units. If the feeder support rails are also removed, the inside of the coal scale body is entirely free of operating parts. The inside of the scale is then clear for cleaning and painting. If this work is done occasionally, the scale body should last indefinitely.

The sub-assembly idea is exclusive with S-E-Co. Coal Scales. This is another reason why these units will give the best coal scale operation.



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STOCK EQUIPMENT COMPANY

715P Hanna Building ★ Cleveland 15, Ohio

intended for measuring smoke density according to some scale, either within the stack itself or as it issues from the stack (2) those that give a quantitative measurement of degree of smoke pollution in an atmosphere (3) those that primarily operate combustion aids and do not measure smoke density except indirectly. Only the first of these groups is considered here.

The authors discuss under qualitative methods the Ringelmann chart and the umbrascope. They point out the major objections to the Ringlemann chart as: (1) Apparent density of smoke depends on amount of light coming through the smoke to the observer and hence depends on nature of background. (2) Wind velocity affects it greatly. The stronger the wind, the more the smoke is scattered and appears thin. When air is still, smoke accumulates, giving a denser appearance. (3) High relative humidity intensifies apparent density. (4) Size of chimney causes a marked change in apparent density. The larger the chimney, the denser the smoke appears. (5) Smoke inspector has a problem of judging comparative density of two widely spaced surfaces, that is, the Ringelmann chart and the smoke.

The quantitative measures covered are the filter spot, deposits, light-transmission methods, and lastly electrical precipitation.

The tests run by the authors show that a given smoke sample of a certain value by one method may have a variety of values when measured by some other procedure. On the other hand, smoke samples that display this wide difference when measured by one procedure may be indistinguishable by a procedure such as a photoelectric one. The authors reach the conclusion that each method measures different aspects of smoke and not smoke itself. *ASHVE paper. No number.*

Directions for ordering papers on p 156

HEAT PUMP

THEORY OF EARTH HEAT EXCHANGERS FOR THE HEAT PUMP, *by L R Ingersoll, F T Adler, A C Ingersoll, University of Wisconsin, and H J Plass, Stanford University.* The earth is the most-discussed source of heat for reverse-cycle heating because of availability, temperature and other considerations. While the small pipe, either relatively isolated or in hairpin loops, is probably the most effective means for use in such heat extraction and is the one that has received most attention, theoretical or experimental, there are a number of other forms of exchangers that should be studied. These include the flat surface

Oil Burner Performance Revolutionized by

Coppus-Dennis FANMIX® Action

Jet reaction of steam-atomized oil is utilized in Coppus-Dennis FANMIX Oil Burners to rotate a fan which is an integral part of the burner. The air delivered by the fan is forced through a sheet of atomized oil, discharged from jets on a rotating disc. An ideal mixture for fast, complete combustion and peak efficiency is thus created.

FIELD-TESTED FOR MORE THAN 2 YEARS

Thoroughly proved in important installations for more than two years, these unique burners have proved profitable investments wherever used. In one of its plants, the American Woolen Company equipped two 1000 hp boilers with six Coppus-Dennis FANMIX Oil Burners.

In Terre Haute, Indiana, Type DC FANMIX Oil Burners were installed early in 1948 on two fully automatic 250 hp steam generators in the Commercial Solvents Corporation plant. They were supplemented by a third FANMIX Oil Burner when another boiler was installed.

ONLY FANMIX OIL BURNERS GIVE YOU ALL 6 FEATURES

1. **INCREASED BOILER RATINGS.** All your furnace is used for combustion, none for mixing. You get higher unit heat releases.
2. **STEPPED UP FUEL EFFICIENCY.** Complete combustion guaranteed with 5% to 10% excess air.
3. **NO "HOT SPOTS."** Continuous explosion kills torch action and disperses heat uniformly throughout furnace.
4. **FORCED DRAFT EQUIPMENT ELIMINATED.** FANMIX action overcomes entire draft loss across burners. No blowers, duct work needed.
5. **STACK REQUIREMENTS CUT** in new installations. Boiler ratings increased with your present stack. Forced draft created by FANMIX action requires less furnace draft.
6. **COKING OF ATOMIZERS REDUCED.** Tips air cooled by fan blades to point well below coking temperature. Less downtime, lower maintenance costs.

ANOTHER **COPPUS** "BLUE RIBBON" PRODUCT

IT WILL PAY YOU to learn the full details on why Coppus-Dennis FANMIX Oil Burners, made to Coppus "Blue Ribbon" standards of quality, promise superior performance. Send coupon today.

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VALVES

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Stainless
Steel
Bar Stock
Valve

R-P&C Bar Stock Valves are an achievement of the valve makers' craft. They are precision turned . . . from carefully tested metals . . . and suitable for a wide range of pressures and temperatures . . . for meter, gauge, test, and general purposes.

● Rugged construction of R-P&C Bar Stock Valves means long, low-cost, trouble-free service. No better bar stock valves are made. See your R-P&C distributor today or write the nearest R-P&C district office for information.

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"Intentionally Better"
READING-PRATT & CADY VALVES

and flat plate, the large cavity or "buried cistern," pipes of various sizes, large and small, long and short, and various forms of pipe grids. This paper is a brief presentation of the theory applying to these various forms, together with a comparative study of their efficiencies. It includes a treatment of some phases of the subject that have previously been little discussed.

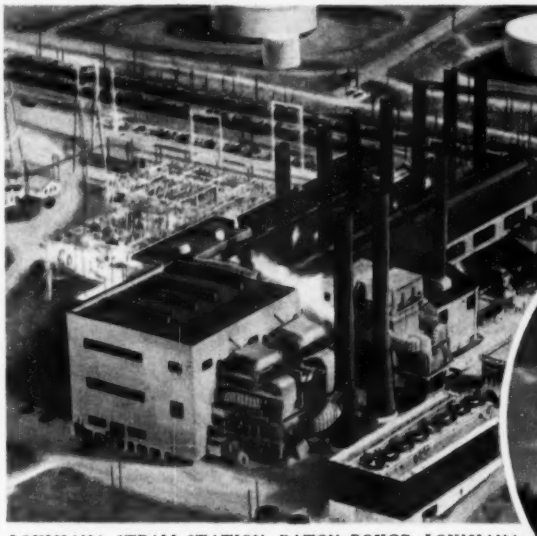
Results show that planar exchangers and roughly spherical cavities are both inferior to the relatively isolated pipe, on the basis of exchanger rate per unit area. On same basis, a small pipe is more efficient than larger ones. Flat and star grids, and closely-wound pipe helices are all of questionable efficiency. Hairpin loop with the two parts well separated in a trench should show good efficiency. But two loops in same trench lower efficiency. Lack of ground-temperature recovery in summer is not important unless winter operation has cooled a large block of ground deeper than some 20 ft. Freezing of moist soil around exchanger pipe retards cooling somewhat—about 10%. Moisture migration tends to increase heat-pump efficiency. Underground-water movement becomes of notable importance only when the velocity exceeds 0.01 ft per hr. *ASHVE paper. No number.*

Directions for ordering papers on p 156

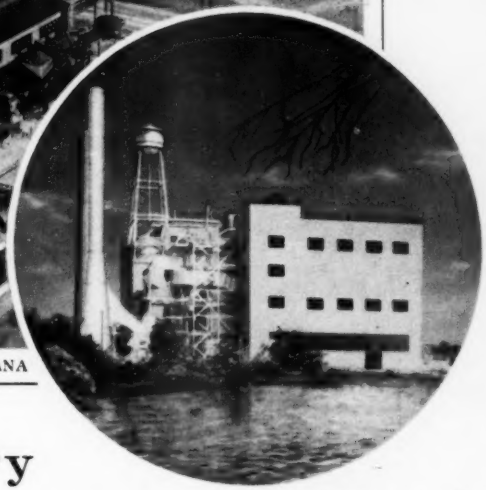
POWER NEWS

(*Continued from page* 152)

flues and ducts when built by the manufacturer reporting and used as part of the complete generating unit; pulverizers and related combustion equipment installed for the primary purpose of pulverizing solid fuel for firing any type furnace except those for locomotive use; steam condensers of the surface, jet or barometric type, inter- and after-condensers and steam-jet air ejectors or any combination used in the generation of power, except locomotives; oil circuit breakers of 2200 v or higher; air circuit breakers except type AB, ET or similar; power switchgear including all equipment for control and protection of apparatus used for power generation, conversion, transmission and distribution including disconnecting switches, bus supports, fittings, associated interconnections and supporting structures, buses and bus structures 2200 v and above, cutouts, power fuses, and current-limiting resistors; metalclad switchgear containing oil circuit breakers, 2200 v and above, or air circuit breakers except type AB, ET or similar, and power switchboards; liquid-filled and dry-type transformers with a capacity of 501 kva and larger designed



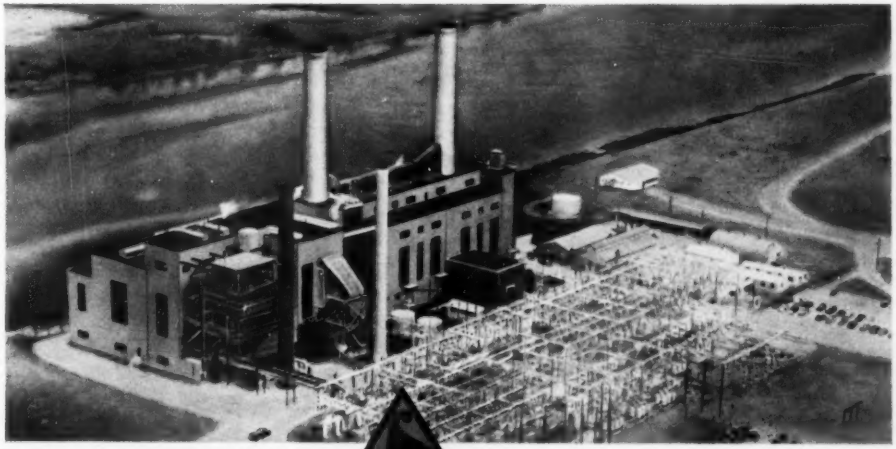
LOUISIANA STEAM STATION, BATON ROUGE, LOUISIANA



RIVERSIDE STATION, LAKE CHARLES, LOUISIANA

Magnet for Industry

Industry has been drawn to the Louisiana and East Texas area of Gulf States Utilities Company by a plentiful power supply. Recently completed additions and work in progress will bring the total generating capacity of the system to over 600,000 kw. With the exception of 35,000 kw partially installed at Riverside when it was acquired by Gulf States Utilities Company, all of this capacity has been designed and constructed by Stone & Webster Engineering Corporation.



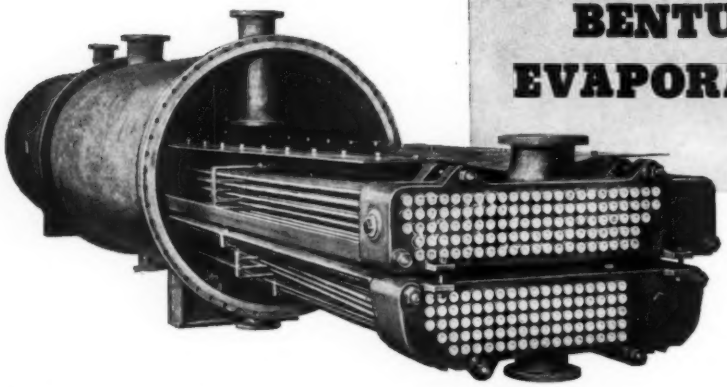
NECHES STATION, BEAUMONT, TEXAS

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

PUREST Make-Up Water

from the ..... **G-R BENTUBE EVAPORATOR**



NO MATTER what the kind or amount of impurities in your feedwater supply, you can count on getting pure distilled boiler feed make-up from a G-R Bentube Evaporator. This make-up water is, in fact, *purer than that obtainable by any other method.* Its hardness is as low as one part per million. Silica content can be reduced to one-tenth part per million.

You can be sure, too, that a G-R Bentube Evaporator will maintain rated capacity throughout its long life. That's because of the patented design of the G-R Bentube elements, which are set with a slight initial curvature into the cast headers. *This exclusive scale-shedding design completely eliminates hand scaling.* Variations in temperature cause changes in the curvature of the tubes, thereby shedding the scale from the tube surface at regular cracking periods and during normal operation.

In addition, the G-R Bentube Evaporator offers distinctive features that assure 100% effective evaporating surface, pure dry vapor, minimum pressure drop of steam through the evaporator, free dropping of scale to the bottom of the shell and convenient access to the shell interior.

BULLETIN 366 *fully describes the wide-range line of* G-R BENTUBE EVAPORATORS. *Write for your copy today.*

THE GRISCOM-RUSSELL CO. • 285 MADISON AVE., NEW YORK 17, N. Y.

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

VARIETY

is not the spice of life here but it

Permits Piping Improvement

Midwest offers a large variety of welding fittings to help *you* improve *your* piping. Many of these fittings were originated by Midwest for the purpose.

For example, the Midwest Reducing Elbow saves a third of the welding, decreases turbulence and pressure drop and improves appearance when used instead of a standard elbow and reducer. Midwest Long Tangent Elbows have a tangent or straight section at each end equal to ¼ the nominal pipe size; this saves pipe, saves time in lining up, and often saves welding. (These are in addition to ASA Type and Short Radius Elbows.) Midwest Sleeves relieve the line butt weld of all bending stress and much of the tensile stress. Midwest Saddles restore the original pipe strength and reinforce the joint.

Use of Midwest Welding Fittings assures maximum improvement and economy in piping. For your welding fitting needs, get in touch with the Midwest Distributor near you.

MIDWEST

PIPING & SUPPLY COMPANY, Inc.

MAIN OFFICES: 1450 SO. SECOND STREET, ST. LOUIS 4, MO.
Sales Offices: New York 7—30 Church St. • Chicago 3—79 W. Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—244 Wright Bldg. • South Boston 27—426 First St.
Stocking Distributors in All Principal Cities

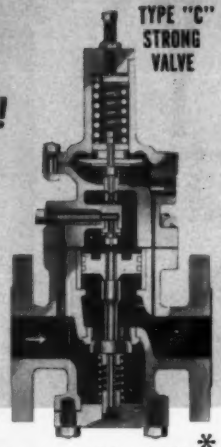
MIDWEST WELDING FITTINGS Improve Piping Designs and Reduce Costs

GET THIS VALVE!

Accurate pressure regulation!

FOR HEATING OR PROCESS JOBS:

- ... with intermittent or fluctuating demand;
- ... requiring accurate control;
- ... where dependability is essential.



For positive control, use this STRONG* single-seated, pilot-controlled valve!

Simple design, extra-heavy construction make STRONG's Type "C" regulating valve give trouble-free regulation. Semi-steel for pressures to 250 psi, 450° F.; cast steel to 600 psi, 750° F. With Anum-Metl† seat and disc, this valve automatically adjusts itself to control the flow of steam, air or gas required to maintain reduced pressure.

Write us about your pressure reducing problem or request our complete steam specialties Catalog 68-P.

TYPE "O"

Direct operated. Semi-steel construction suitable for initial pressures to 225 psi, 400° F. For steam, air, water or gas.

Features internal strainer, Anum-Metl† seat and disc. Direct operated, of extra heavy semi-steel, this valve is suitable for pressures to 225 psi, 400° F.

TYPE "K"

*Trade Mark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY

1392 WEST 3rd Street
Cleveland 13, Ohio

† ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

No. 070 Small Trap — "SY" Strainer — 800 Series Steel Trap

STRONG

for single-phase and multiple-phase operation above 15 kv.

Any person affected by any provision of this order may file with NPA a request for adjustment or exception upon the grounds that such provision works an undue or exceptional hardship upon him not suffered generally by others in the same trade or industry, or that its enforcement against him would not be in the interest of national defense or the public interest.

Ninth Annual Anthracite Conference scheduled for Lehigh University Campus, May 4, will center around the role of the anthracite industry in the present national emergency. Professor A Copeland Callen, mining dept head at the university, has been named general chairman of the conference with R C Johnson, vice-president of the Anthracite Institute, as vice-chairman.

Air Pollution and Smoke Prevention Assn of America will hold its 44th annual meeting at the Hotel Roanoke, Roanoke, Va., May 6-10, 1951. An extensive technical and plant-visits program has been planned. Technical sessions will cover problems of preparing and burning coal as a fuel, flyash collection, air-pollution problems peculiar to the chemical industry.

Cummins Engine Co has announced its second major expansion in the last few months. The most recent includes an immediate extension, 9600 sq ft, on the fuel-pump building and new machinery for increasing manufacturing capacity for the recently announced *Cummins DD* fuel pump and component parts.

With Power Readers

(*Continued from page 5*)

the army with no opportunity of specializing in his chosen field.

Why can't this boy complete his college education, get his engineering degree, and then go into military service as a highly skilled man? Isn't there any value on engineering and scientific ability? Why isn't the sound advice of engineering societies accepted? To us close to the picture, it is a careless approach to the future of our outstanding young men. I hope this letter serves the purpose for which it is intended, that is, to give a specific case with authentic facts.

Altadena, Calif. C M LEFLANG

SCARCITY OF ENGINEERS . . .

It was indeed gratifying to read your editorial in February POWER *and Dean Hollister's article in "Electrical Engineering" telling of the scarcity of engineers. For years engineers have been kicked around and exploited. May they have a period of prosperity even if it lasts but a decade.*

In both articles . . . emphasis is placed on the college graduate. Of course he is strong physically, can be hired at a low

These tubes go in to stay!

Thanks to CHASE ANTIMONIAL ADMIRALTY

(a patented alloy)

Here's the reason why Chase Antimonial Admiralty* keeps condenser tubes on the job year after year:

They've got *enough* antimony to resist dezincification. And antimony will not affect the metal's grain structure and won't weaken the tube.

When you get Chase Antimonial Admiralty Condenser Tubes, you're getting metal that *stays tough* . . . stands up under heavy stresses . . . lasts for years.

Years of use have proved Chase Antimonial Admiralty's superiority.

*U. S. Pat. No. 2,061,921

Special stocks of
ANTIMONIAL ADMIRALTY
Condenser Tubes in Chase Warehouses:
NEW YORK, BALTIMORE, NEW ORLEANS
LOS ANGELES
also carried by—
Vinson Supply Co., Tulsa
Standard Brass & Mfg. Co., Houston

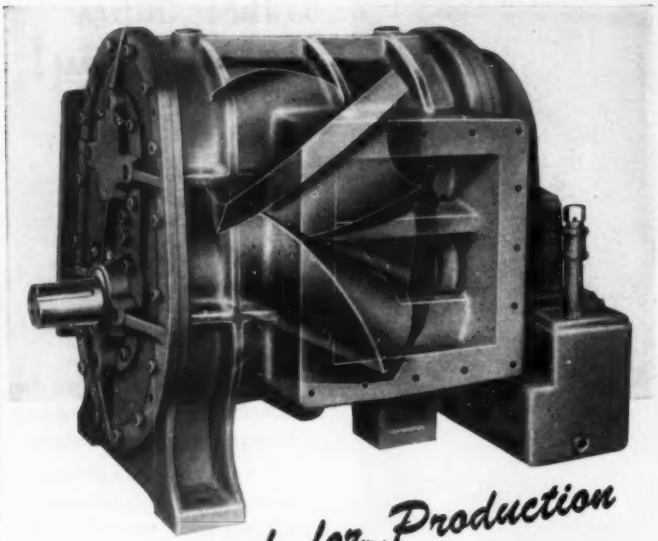
Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

• *The Nation's Headquarters for Brass & Copper*

Albany†	Cleveland	Kansas City, Mo.	New York	San Francisco †
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver †	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit †	Minneapolis	Providence	(†sales
Chicago	Houston†	Newark	Rochester†	office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	

The STANDARDAIRE Axial Flow BLOWER ~



Engineered for Production

TO MEET the increasing demand for Standardaire Blowers our manufacturing facilities have progressed from custom built techniques to precision production methods for the principal components of the blower. In addition to other improvements, new manufacturing processes and equipment are now being used to generate the cycloidal form, screw type main and gate rotors on a production basis without sacrificing precision and accuracy of fit—important details in maintaining the "air screw" action feature of the Standardaire Blower.

Through this unique achievement in production engineering it is possible for Standard Stoker to offer industry a Standardaire Blower with the design features and efficiency of a custom built job at the availability of a quantity production unit.

Consult with our engineers on how the modern design Standardaire Blower can be adapted to suit your requirements. Write Dept. E2 The Standard Stoker Co., Inc., 370 Lexington Avenue, New York 17, New York.

THE STANDARD STOKER CO., INC.

Standard Stoker SSS

NEW YORK • CHICAGO • ERIE • YORK • MONTREAL

rate of pay and is available for temporary jobs. He does not, however, have the experience that makes an engineer. There are thousands of medium and low-salaried engineers who would jump at a "war job" if some assurance of permanence could be given. Most of these men remember only too well the oversupply of engineers in the thirties.

North Platte, Neb. B E ELLSWORTH

BOOKSHELF

(*Continued from page* 168)

nance responsibilities will ultimately revert to the power man.

To the experienced technician, this book will serve as a medium for the exchange of ideas. And to the new arrival in the TV trade it will not only be a source of theory but of suggestions for installation and maintenance.

On the whole, the author follows a general approach in outlining common TV troubles and how to correct them.

BASIC ELECTRICAL MEASUREMENTS. *By Melville B Stout, professor of electrical engineering, University of Michigan.* 6x9, 504 *pp,* $7.75. *Prentice-Hall Inc, 70 Fifth Ave, New York* 11, *N. Y.*

This is intended as an undergraduate text; hence no attempt is made to present all equipment and arrangements. An attempt has been made, however, to select methods that are most important and most frequently used in present-day practice.

Some of the older ways of measuring resistance have been dropped, in addition to dc bridge methods for measuring inductance and capacitance. The ac bridge is stressed as a versatile and accurate means for performing many types of measurements.

The general scope, ranging from development of electrical units through the various bridges, on to the relatively practical chapter on electrical-indicating instruments, envelopes a segment of the electrical measurements art that should prove beneficial to those seeking a broader understanding of instrumentation principles.

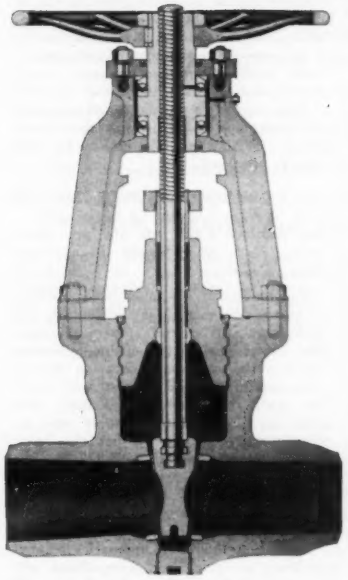
FUELS AND COMBUSTION HANDBOOK. *By Allen J Johnson, consulting engineer (editor), and George H Auth, professor, mechanical engineering, Villanova College (associate editor).* 915 *pp,* 6x9¼, *leather, illust, tables, charts, drawings.* $12.50. *McGraw-Hill Book Co,* 330 *W* 42*nd St, New York* 18, *N. Y.*

"Fuel is the backbone of all industrial prosperity, the use of heat and power, an index of a nation's degree of advancement. A better understanding of the characteristic properties of individual fuels and of the several fuels as related to each other paves the way for a more intelligent fuel selection and resultant economies and improvements in operation."

These remarks from the preface give an excellent summary of the reason for the handbook and its aims. These aims have been constantly kept in mind. As an example of the constant awareness of the purpose of the book, the authors have tried to make it as comprehensive (some

CONTROLLED POWER...

WITH LUNKENHEIMER *Breech Lock Valves*



VENTURI OR FULLWAY ENDS

1500 Lbs. Cast-Steel Breech Lock Gate Valve

The Lunkenheimer body-bonnet Breech Lock valve follows the principle used in large guns, except that locking is not accomplished by a thread wedging action. Rather, four series of three heavy annular lugs on the bonnet and in the body intermesh and lock the two parts together. Stress is evenly distributed, and the full internal pressure is carried by the breech lugs. Pressure tightness is maintained by sealing the joint with a seal weld, which can be chipped out to release the bonnet, if necessary.

The combination of lugs and seal weld possesses a strength and structural stability not attainable in any type of construction that must depend upon some form of gasket for pressure-tightness. Also, a joint is virtually eliminated by the integral union of body and bonnet with a seal weld. *Leakage is impossible, and maintenance never required.* In effect, the Breech Lock with Seal Weld has all the advantages of the Strength Welded Bonnet design, plus the added advantage of easy disassembly and reassembly in the field.

Write for your copy of "Lunkenheimer Cast Steels," a brochure describing basic research in alloys for high-pressure, high-temperature valves. Address: The Lunkenheimer Company, Box 360A, Cincinnati 14, Ohio.

STEEL • IRON • BRONZE

LUNKENHEIMER

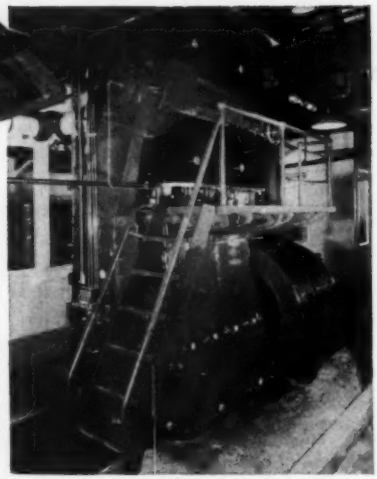
THE ONE *Great* NAME IN VALVES

L-251-6

Since 1913

SKINNER ENGINE-GENERATOR UNITS

have supplied the electric power
at Eastern Tanners Glue Division of Peter Cooper Corporations



A repeat order is the best evidence of satisfaction, and the Eastern Tanners Glue Division of Peter Cooper Corporations, Gowanda, N.Y. furnishes additional testimony to that fact.

In 1913, two 200-kw. Skinner Engine-Generator units were installed in this plant. By 1924, three additional units were added. Recently a two-cylinder Skinner Vertical "Universal Unaflow" Steam Engine, directly connected to a 400-kw. D.C. generator, was installed. All six engines are still in operation and have a total capacity of 1500 kw.

Eastern Tanners Glue, like many others who have enlarged their plant capacity, have found it more economical to install additional Skinner "Universal Unaflow" Steam Engines to meet their increased power requirements.

Our engineers will make accurate estimates to prove you can produce dependable power at a fraction of the cost of purchased power. Write for detailed information of the advantages of Skinner "Universal Unaflow" Engines in your field.

For Over 80 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

450 major references) and up-to-date as possible. Over 50% of the material is less than 5 years old, over 80% less than 10. Considerable attention went into the index on the theory that no reference book is any better than its index. A highly commendable idea.

Scope of the handbook is impressive. There are eight major sections: Solid Fuels, Liquid and Gaseous Fuels, Combustion, Fuel Selection, Coal Preparation, Fuel Handling, Transfer and Generation of Heat, General.

In Fuel Selection, particularly, alignment charts and a heavy use of tables and graphs help in reaching fairly quick answers to specific problems as well as establishing an understanding of topics discussed.

CIRCUIT ANALYSIS OF AC POWER SYSTEMS (*Vol II*). *By Edith Clarke, professor of electrical engineering, University of Texas.* 6x9, 396 *pp*, $8.50. *John Wiley & Sons*, 410 *Fourth Ave, New York* 16, *N. Y.*

Carrying on from Vol I, the author provides curves and charts for determining skin effect and proximity effect in circuits of nonmagnetic solid and tubular conductors. You will also find equivalent circuits for 3-phase transformers and autotransformers. This additional material extends the study of banks of single-phase units given in Vol I; 4- and 5-winding units and their equivalent circuits are included.

A description is included on the effects of open conductors in 3-phase circuits applying to ungrounded transformer banks. It includes charts that show the conditions under which high-voltage or phase reversal of induction motors, or both, may occur.

Book provides a method for determining odd harmonics during unsymmetrical short circuits. This method is given here the first time in any book.

THE ENGINEERING METHOD. *By John C L Fish, emeritus professor of civil engineering, Stanford Univ.* 9x6, 186 *pp, illust, tables, cloth*, $3. *Stanford Univ Press, Stanford, Calif.*

The process of reasoning from question to answer varies with the individual, his background, his control of personal bias. The professional habit of the scientist, the engineer, and some others to pursue reasoning in a rational yet systematic manner, with entire devotion to truth, has often been referred to by these men as the "scientific method." It has also been called the "engineering method."

As the author presents the subject, every man's mental workshop has three special machines, an analyzer, an evaluator and a synthesizer or integrator.

Several methods of approach to any problem are given and comparisons set up among them. Then the factors of point-influence are brought into the discussion. These factors include both quantitative and qualitative judgment.

Later in the book specific problems are raised, for instance the one of selecting a certain river water as the proper source of water supply for San Francisco.

The material is developed to interest (1) undergraduate and graduate students, young practitioners and teachers of engi-

NOTES for the Power Engineer

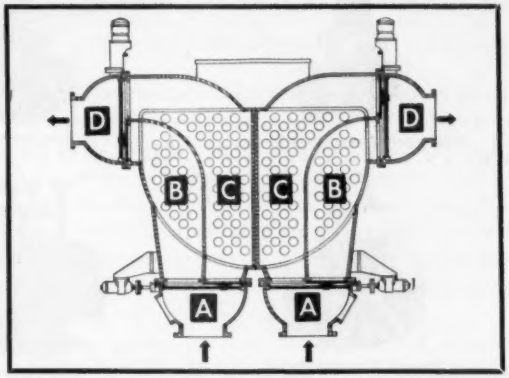
C. H. Wheeler OF PHILADELPHIA

STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM
PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

"REVERSE FLOW" CONDENSERS

SOLVE YOUR CLEANING PROBLEMS—REDUCE OPERATING COSTS

These advantages are possible only in C. H. Wheeler's unique design of an integral reverse-flow steam condenser. By an arrangement of electrically or hydraulically controlled sluice gates, the flow of water through the condenser tubes is reversed. Refuse is rapidly and thoroughly flushed down the discharge in a matter of minutes, without shutdown of the unit. In addition to saving cleaning time and eliminating labor costs, you improve the efficiency of the whole unit by not reducing load. The need for expensive mechanical water straining apparatus is also eliminated. Reverse-Flow may be incorporated in either divided or non-divided water boxes.



CROSS-SECTION DUAL BANK CONDENSER SHOWING HOW "REVERSE FLOW" WORKS

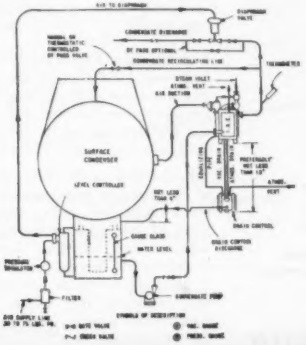
Both halves work the same but independently of each other.

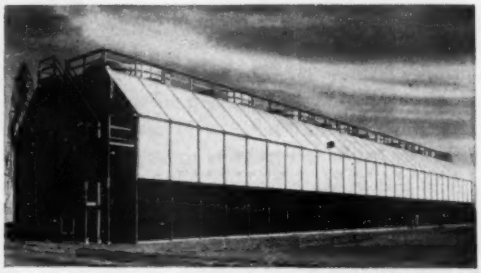
Left Side: Water enters divided water box at valve chamber A, with left port open. It flows through pass B to end of condenser, back through pass C and out through upper port of D.

Right Side: Flow is reversed: Valves at inlet A and discharge D are changed to permit water to flow through C and back through B in the opposite direction, then out through lower port of D.

RECOMMENDED HOTWELL LEVEL CONTROL WITH TUBEJET AIR EJECTOR

This diagram is typical of the information awaiting you in Specification 88. This 4-page illustrated bulletin describes the improved steel shell Tubejet Air Ejectors with combined surface type inter-after condenser. Many power plant engineers are adopting this more reliable, space saving equipment for stationary power plant use. A request on your company letterhead will bring a copy of Specification 88 by return mail.





C. H. WHEELER COOLING TOWERS Selected by CITY PUBLIC SERVICE BOARD SAN ANTONIO, TEXAS

Gibbs & Hill, Inc., Engineers & Constructors

One 30,000 gpm induced-draft cooling tower is already in place at the Leon Creek Power Station. The second tower for the same capacity is now being constructed. Each of these towers supplies a 30,000-kw preferred-standard turbine-generator, and is designed to cool water from 105.5F to 90F at a wet bulb of 76.5F. *Features of these and other C. H. Wheeler Cooling Towers are described in Catalog 145. This and the popular 16-page book, "Cooling Tower Maintenance," will be mailed on request.*

C. H. WHEELER MANUFACTURING CO. 1000 N. DELLEY AVE., PHILADELPHIA 22, PA.

(Advertisement)

You Get Longer Service, Less Maintenance, Greater All-Around Dependability with

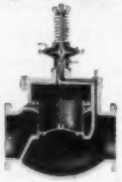
GOLDEN-ANDERSON

Cushioned

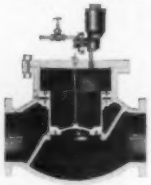
Steam and Water Pressure Valves

One of these eight valves will ideally meet your requirements

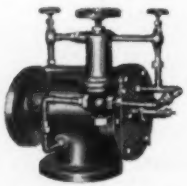
Single-Acting Non-Return Valve



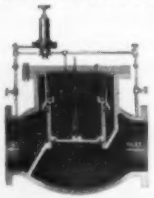
Altitude Control Valve



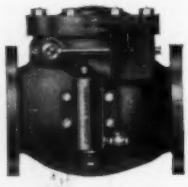
Solenoid Operated Electric Water Service Valve



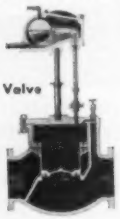
Surge Relief Valve



Water Pressure Reducing Valve



Swing Check Valve



Cold Water Float Valve

Triple-Acting Non-Return Valve

Our descriptive bulletins covering these various valves gladly sent on request.

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neers (2) engineers with engineering assistants needing some "rules of the game" (3) experienced engineers wanting some single point of reference on the engineering method (4) non-engineers seeking to apply this approach to their own problems.

ENGINEERING MECHANICS (*3rd edition*). *By S Timoshenko and D H Young, professors of engineering mechanics, Stanford University,* 516 *pp,* 6x9, 736 *illust,* 196 *examples,* 650 *unsolved problems, cloth,* $5.50. *McGraw-Hill Book Co, Inc,* 330 *W* 42*nd St, New York* 18, *N. Y.*

This widely used, basic undergraduate textbook has been revised to add about 300 new unsolved problems (answers given but not solutions), including a high proportion of straight-forward questions that do not overemphasize trigonometric or geometric ingenuity.

As in other editions, the aim is to acquaint the student with as many general methods of attack as possible and to illustrate their application to practical engineering problems. Part I, Statics, assumes a mathematical knowledge of differential calculus, while Part II, Dynamics, makes free use of both differential and integral calculus, including some elementary differential equations.

INTRODUCTION TO SERVOMECHANISMS. *By A Porter, head of research dept, Ferranti Electric Ltd, Toronto, Canada,* 154 *pp,* 70 *diagrams,* 4¼x6½, *cloth,* $1.75. *John Wiley & Sons, Inc,* 440 *Fourth Ave, New York* 16, *N. Y.*

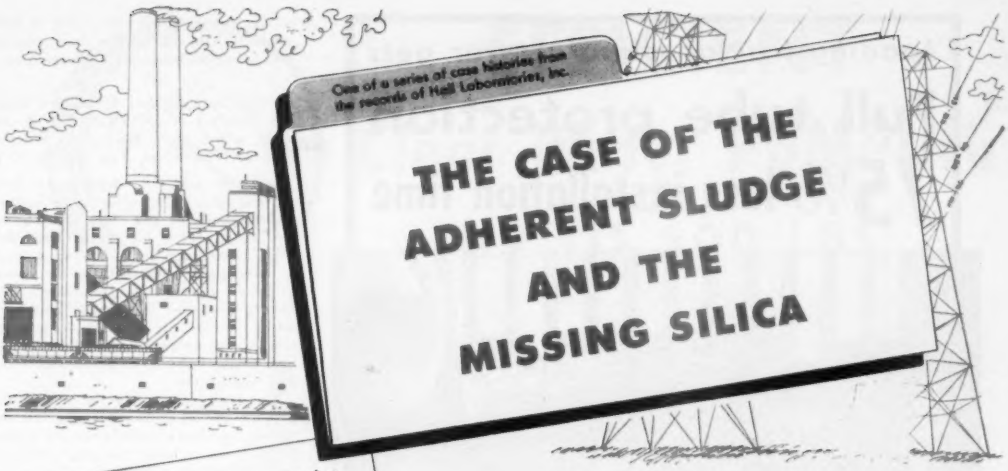
Based on a series of lectures delivered by the author at the Military College of Science, Shrivenham, England. This book sets forth the basic theory of servomechanisms in the field of automatic control, a servomechanism being a device to transmit and amplify a control signal into a control operation. While this book is written primarily for students and engineers *interested* in the subject rather than those who specialize in the theory and design of automatic control systems, its highly mathematical treatment may scare away the average engineer seeking only a working knowledge.

Six chapters cover closed-sequence control systems, basic equations of linear servosystems, transient and steady-state behavior, harmonic response diagrams, lag correction and stabilization, nonlinear problems.

TRANSFORMER ENGINEERING. *By the late L F Blume, A Boyajian, G Camilli, T C Lennox, S Minneci, V M Montsinger—all of transformer engineering div, General Electric Co.* 6x9, 500 *pp,* $7.50. *John Wiley & Sons,* 440 *Fourth Ave, New York* 16, *N. Y.*

A detailed study of about every phase of transformer performance. Connections, phase-angle, load ratio control, characteristics of insulation materials, etc. Recent advances are included; for instance, in Chapter 9 on Thermal Characteristics, data is provided to enable the engineer to obtain maximum safe output under short-time overloads with moderate sacrifice of life expectancy.

Then in Chapter 15 you will find new material on insulation. This includes data



One of a series of case histories from the records of Hall Laboratories, Inc.

THE CASE OF THE ADHERENT SLUDGE AND THE MISSING SILICA

All boiler feedwater contains, among other things, magnesium and calcium.

Since calcium gets into bad company and forms scale we add phosphate and get calcium phosphate sludge which is easily removed.

But if there isn't enough work to keep all the phosphate busy, it, too gets into mischief combining with magnesium to form a sticky magnesium phosphate sludge.

Magnesium however, prefers the company of silica so where magnesium-phosphate is a problem, we add silica and get easily removed magnesium silicate sludge

The problem of hard scales of calcium silicate, calcium sulphate, calcium carbonate was virtually eliminated when Hall Laboratories showed how to use phosphate for the conditioning of boiler water.

With the advent of high-pressure boilers, however, scales of sodium aluminum silicate and other complex silicates began to appear. One obvious remedy was the elimination of silica, and other constituents of these scales, from the boiler water. Effective procedures for accomplishing this were developed, and the desirability of silica-free boiler water was accepted without question.

Then another problem came to the fore—a sticky, adherent sludge in which magnesium phosphate proved to be the bad actor. What Hall Laboratories proposed was sheer heresy at the time: even if silica must be deliberately added, keep enough silica in the boiler water to precipitate all of the magnesium as magnesium silicate, removed readily by normal blowdown.

This violated all rules—but it worked. Today, silica treatment is accepted as a standard method of preventing the formation of adherent magnesium phosphate sludge.

For more than a quarter of a century Hall Laboratories has been *creating* precedents in industrial water treatment—solving new problems with full knowledge of accepted practices, but devising new techniques whenever old ideas prove to be inadequate.

Hall Laboratories is prepared to assist you in the solution of any problem involving the procurement, usage, treatment, or disposal of industrial water. For more detailed information on the nature and scope of these services, just fill out and mail the coupon.

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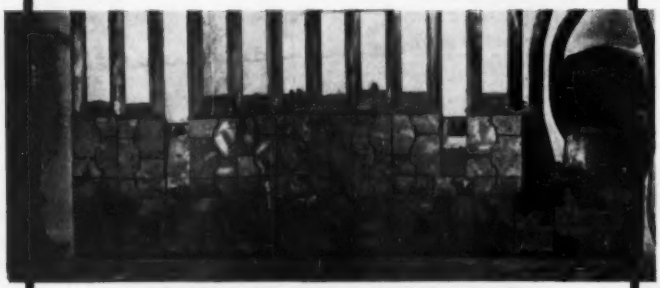

with Bernitz-Nygaard Carbofrax* Water Wall Armor

EQUIPMENT: Detroit Roto Grate Stoker, Murray Iron Works Boiler capacity: 75000 #/hr.
Hoffman Firite Travelling Grate Stoker, Wickes Boiler capacity: 50000 #/hr.

PROBLEM: In both boilers coal built up coking on exposed rear wall refractories, caused etching and tube corrosion. Tubes on side walls also failed because of **abrasion** of coal against tubes. Furnace too cold at low ratings.

SOLUTION: Bernitz-Nygaard Water Wall Blocks installed above grates on side and rear walls. Corrosion and etching problems completely solved. Furnaces much hotter at low ratings. Smoke problem eliminated. Blocks installed from furnace interior without disturbing outer brickwork. Installation time cut 75% over **cast iron armor.**

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1. Longer tube life through reduction of abrasion, clinker adhesion and slag erosion.
2. Reduced outages for refractory repair, even with high sulphur fuels. Blocks last up to 20 years without service.
3. Increased furnace capacity and efficiency.

Inset shows rear water wall header protection blocks.
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on the complete volt-time curve of solid insulation and oil, ranging from approximately one microsecond to infinite time.

ION-EXCHANGE RESINS. *By Robert Kunin and Robert J Myers.* 9¼x6, 212 *pp,* 104 *illust, tables, cloth,* $4.75. *John Wiley & Sons, 440 Fourth Ave, New York* 16, *N. Y.*

In recent years ion exchange has been popping up as a live subject in agriculture, biology, medicine and chemistry. The recent appearance of high-capacity and durable ion-exchange resins has done much to stimulate this interest. In the course of their business lives, the authors have had to assemble, digest and classify a sizable portion of all available information on this subject. In fact, one of the high spots of the book is the very excellent bibliography.

The book summarizes the theory and practice of ion-exchange resins. It discusses the theory underlying the mechanisms of ion exchange and the operational and engineering data associated with the exchange resins. For power men there is an interesting chapter on water softening by ion exchange.

THE PRACTICE OF LUBRICATION. *By T C Thomsen, consulting lubrication engineer (Copenhagen, Denmark).* 6½x9½, 617 *pp,* $8. *McGraw-Hill Book Co,* 330 *W 42nd St, New York* 18, *N. Y.*

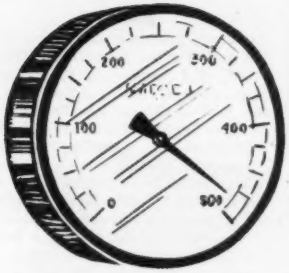
Comprehensive coverage of the origin, nature, testing, selection, application and use of all type lubricants. It gives some of the factors involved in industrial lubrication in simple language. It is slanted for practicing lubrication and mechanical engineers, manufacturers and designers of engines and machinery, and those responsible for plant lubrication.

Lube data relate to advances in engine and machinery construction, involving high pressures and temperature extremes along with progress made in lubricants manufacture. Information is included on the manufacture of engine-oil inhibitors with a separate chapter devoted to their use.

THEORY AND APPLICATION OF INDUSTRIAL ELECTRONICS (1951). *By John M Cage, professor of electrical engineering, Purdue University, assisted by C J Bashe, research engineer, International Business Machine Corp.* 290 *pp,* 6x9, *illust, cloth.* $4.75. *McGraw-Hill Book Co,* 330 *W 42nd St, New York* 18, *N. Y.*

Written primarily for college and undergraduate courses in industrial electronics, this book also meets the needs of practicing engineers who wish to review the principles of electronic devices used in industry. It covers polyphase rectifiers, grid-control circuits for gas tubes, regulators and servomotors, electronic control for motors and generators, timing circuits, ignitrons and thyratrons as line switches, resistance-welder circuits, induction and dielectric heating, electronic measurements and oscillators. Control, power conversion and measurements are treated with emphasis on fundamental principles built up with typical applications.

(*Booklet reviews on page* 214)



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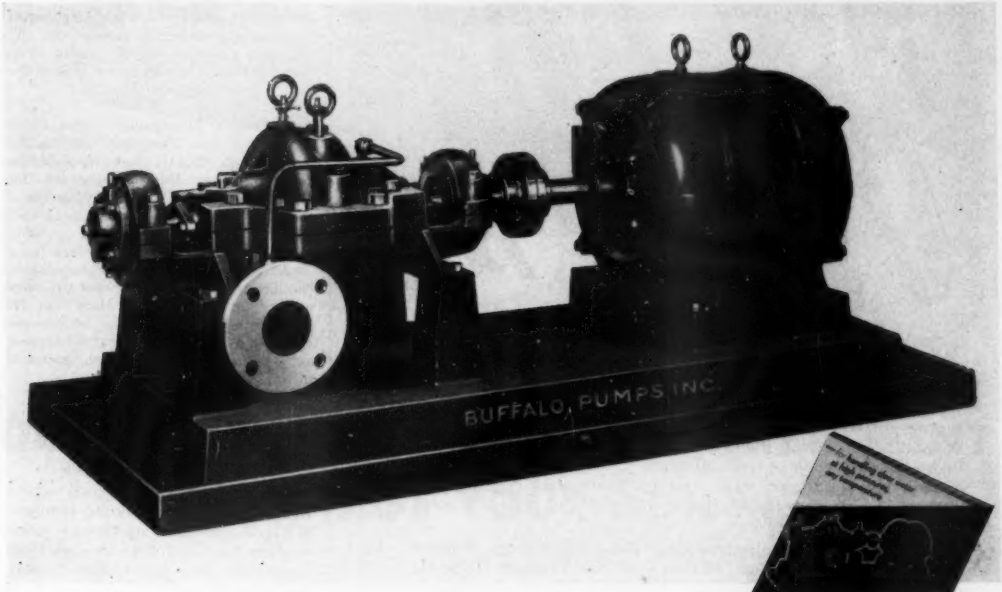
Clear Water PUMPING
UP TO 500 LBS.



"Buffalo" CLASS "RR" PUMPS

For boiler feed and other clear water service where high pressures are encountered, "Buffalo" Class "RR" Pumps are a top value! On-the-job efficiencies are high. And, of prime importance to the user, these pumps are built to last. The photo above of a 2-stage "RR" shows the ample, heavy base, the oversize bearings and shaft, the generous thickness of the pump casing. All other parts are equally heavy-duty. WRITE FOR BULLETIN 980-B for the complete picture on "Buffalo" Class "RR" Pumps. They're available in 2- and 4-stage models with capacities up to 900 gpm.

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A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

COLLECTS MORE DUST

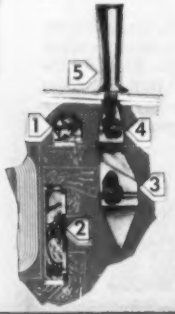
in the *ultra-fine* particle range

VALMONT TYPE S

With Prat-Daniel Dust Collectors, an extremely high percentage of the ultra-fine particles are removed from the gas stream. Long, narrow inlets on tubes of small diameter produce high efficiency even at reduced loads. The low velocity reduces erosion and combined with wear-resistant steel construction gives P-D collectors the desired combination of high efficiency and exceptionally long life.

All types of P-D Collectors meet the requirements of most dust ordinances; the high efficiency of the Valmont Type S, however, exceeds the requirements of many of the most stringent ordinances.

"Uni-block" construction, with complete tube sections assembled at the factory, makes relatively low installation costs possible. Hundreds of installations have proved P-D Collectors' all-'round efficiency and low maintenance costs provide a high return on investment. Get the best in dust collectors for your plant. Write our Sales and Project Engineers for Catalog No. 250S.



UNIT RESPONSIBILITY

Prat-Daniel, through its sales and project engineers, The Thermix Corp., offer a complete complement for handling the air gas stream shown at left; 1. Forced Draft Fans, 2. Air Preheaters, 3. Tubular Dust Collectors, 4. Induced Draft Fans and 5. Fan Stacks. This unit responsibility, by a well-known firm, relieves the engineer of the responsibility for one of the most important functions in a steam generating plant.

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BOOKLETS

AMERICAN STANDARD ABBREVIATIONS FOR USE ON DRAWINGS. *Sponsored by AIEE and ASME, ASA Standard* Z32.13-1950. 8½x11, 32 *pp, paper,* $1. *American Standards Assn, Inc, 70 East 45th St, New York 17, N. Y.* Standard has been developed for use where abbreviations are needed on drawings. For guidance in choosing words and abbreviations a set of basic principles was established and closely adhered to. Alphabetical listing covers wide variety of industries—both civilian and military. Also included are abbreviations for valves, colors, cable and magnet wire, screw threads, and partial lists of chemical symbols, engineering societies and industrial associations. All engineers in design and other work where drawings must be used should have this standard for reference.

PROPERTIES OF FLAMMABLE LIQUIDS, GASES AND SOLIDS. *Loss Prevention Bulletin No.* 36.10, 12 *pp,* 8½x11, *paper, available on request. Factory Mutual Engrg Div,* 184 *High St, Boston* 10, *Mass.* Key feature of this edition is a table listing more than 650 flammable materials found in industrial plants. Chemical formula, flash point, explosive limits, auto-ignition temperature, specific gravity and other data are summarized for each material. More than 200 materials not listed in earlier editions are included, as well as additional information on previous listings. Everyone interested in fire prevention needs this booklet.

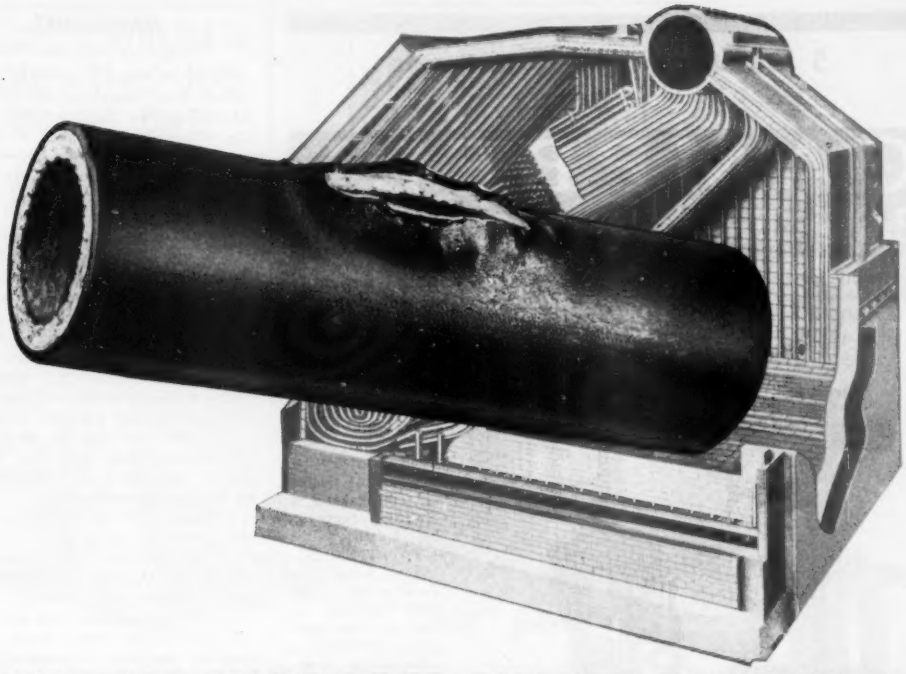
ELECTRONICS

(*Continued from page* 102)

polarity is as shown, the signal current is from B to A. Applying this condition to Fig. 8, current is up through motor winding No. 1 and down through input transformer secondary to bias T_3 plus, as is tubes T_2 and T_4. Current now flows from F to E through No. 2 motor winding, where it flowed from E to F when the signal current was from A to B and power-line polarity was as shown. Reversing the current in No. 2 winding reverses the motor's rotation. All this is done by simply moving the slides up or down on the sending slidewire, Fig. 5. Remember, the power lines are 60-cycle ac so their polarity is changing 120 times a second. When we assume a polarity it is for that instant to study the effects at that time.

We have covered the most important features of the amplifiers. There are others we could discuss, but space will not permit.

In this control both the setting of the sender and the final position of the control elements are shown by voltmeters on the control panel and serve as a check on proper operation. All parts of the amplifiers are assembled in plug-in units. If a part fails, such as a tube, the amplifier can be quickly replaced. When a tube or power fails, the control remains in the last operating position.



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This year, the weakest link in your production program may be *one* boiler tube! The loss of that tube will slow vital production . . . will take longer to replace . . . will cost more.

Modern, up-to-date water conditioning, such as the Drew System, prevents tube failures. Drew's continuing research, its study and investigation of *your* operating and water conditioning problems in its laboratories makes such prevention possible. Drew *insures* the performance of your water conditioning by its dependable and frequent testing and checking service.

That's why Drew is one of America's fastest growing water treatment companies. Industry's most respected names avail themselves of Drew's specialized service. Do the same. Consult the nearest Drew engineer or write for further information.

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Nationwide Service in Boiler Water and Cooling Water Conditioning

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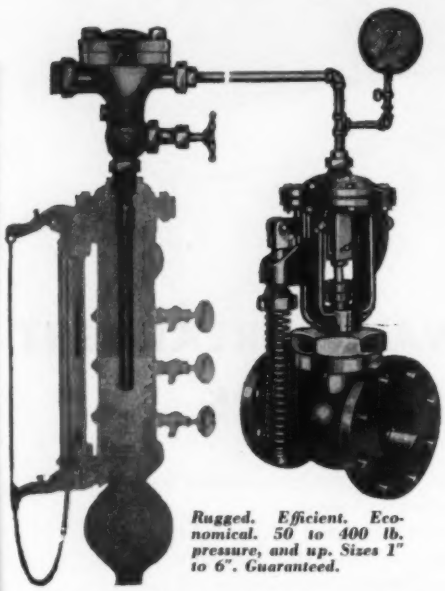
1. **Simplicity.** The outstanding advantage of the CAMPBELL is its simplified construction. No trouble breeding parts whatever. Easy to install. Expert servicing is entirely eliminated. No moving parts. No thermostats. No floats. No links. No generators.



Rugged. Efficient. Economical. 50 to 400 lb. pressure, and up. Sizes 1" to 6". Guaranteed.

2. **Dry Steam Output Assured.** By maintaining a uniform water level the steam leaving the boiler is always dry.
3. **Assists the Boiler in Overtaking a Sudden Increase in Load.** The CAMPBELL slows down the feed when a sudden increase in load develops and gives the boiler a chance to overtake the load before the regulator again feeds at a rate to balance output.
4. **Quickly Restores Water Level.** When a sudden decrease in steam demand causes the water level to drop, the regulator speeds up the water input and quickly restores the water level.
5. **Reduces Operating Costs.** Boilers equipped with the CAMPBELL deliver drier steam, have a more continuous operation, and indicate an appreciable saving in fuel, all of which tend to increase the boiler efficiency.

☐ Super-sensitive Pressure Regulators
☐ Damper Regulators
☐ Temperature Regulators
☐ Reducing Valves
☐ Exhaust Control Systems
☐ Pump Governors
☐ Oil Control Cocks
☐ Humidity Controllers
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Other ATLAS Products

Check those on which you want complete data.

BUT THAT ISN'T ALL

There are other important advantages, such as continuous blowdown and visual indication that are obtainable in the CAMPBELL only and that are covered in Bulletin 8-A. Ask for a copy by placing a check in this square ☐. Also, check the list at the left. Mail to us with your name, firm, and address.

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REGULATING VALVES FOR EVERY SERVICE

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Represented in Principal Cities

MARMADUKE

(*Continued from page* 146)

"Then arriving in New York, I always sent a quart sample to the oil firm's lab for analysis. Those samples showed the saponification number at normal, or about 0.2.

"Shotski relieved me shortly before the oil salesman came aboard for his lab sample.

" 'What in hell kind of monkey business is this?' demanded Shotski. 'Oil is oil, and if Surfaceblow couldn't tell oil by looking at it, he's too damn old to be shipping out.' But the salesman finally got his sample and scrammed.

"A few days later the ship got orders to leave for Bremerhaven, Germany, for a load of displaced persons. She shoved off before the lab reported on the oil.

"A week later the lab phoned the port engineer and told him all the *General Sherman's* oil would have to be dumped immediately.

" 'What's that?' yelled the port engineer, dropping his uppers.

" 'You heard me right,' came back the answer. 'That inhibited oil has completely broken down. Instead of the normal 0.2 sap number, she now reads 2.0. That sudden change means she is probably severely contaminated and breaking down badly.'

" 'When the sap number of an inhibited oil starts to climb that fast,' continued the chemist while the port engineer hung on with his mouth open, 'the oxidation inhibitor is used up and the oil is breaking down at a terrific rate. In this condition, the *Sherman's* plant may be wrecked at any minute.'

" 'Aw shut up!' yelled the port engineer, coming too. He slammed down the receiver, rushed a message to Bremerhaven, then phoned me at the shipyard.

" 'BILGEWATER,' I said, when he accused me of turning the ship over in that condition. 'That oil was perfect. If anything's wrong, it happened after I signed off.'

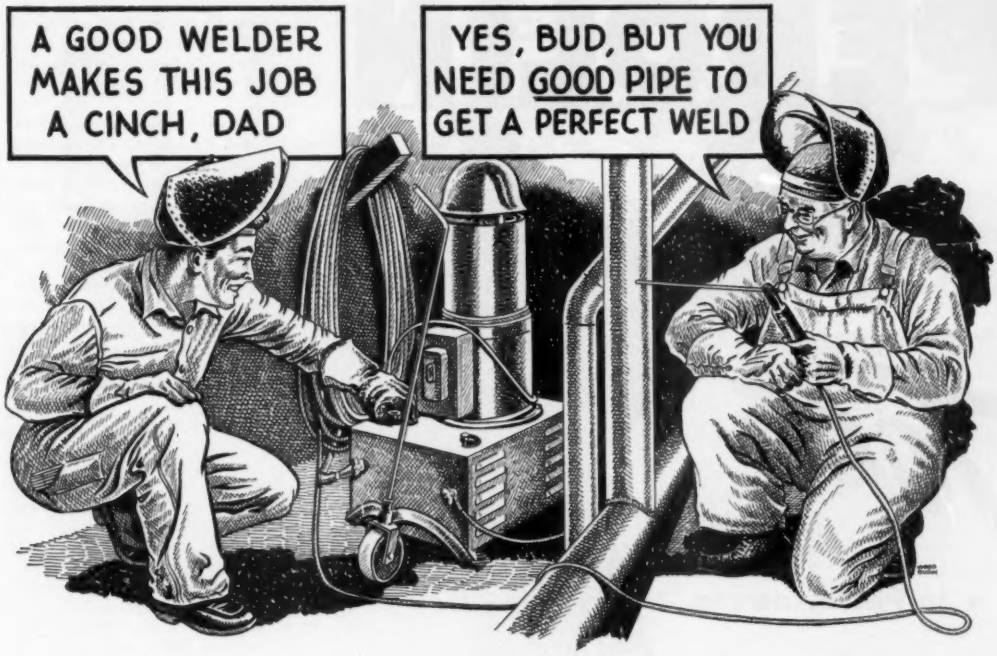
" 'Look here, Surfaceblow, this is a serious mat—', he started to say. But I cut him short.

" 'Keep your britches on! When that tub arrives, I'll go aboard with you and we'll find Shotski's trouble.'

"The message got to Bremerhaven, but the *General Sherman* had sailed for Genoa, Italy, before receiving it. By the time New York learned about the *Sherman* missing her message, she had left for Buenos Aires, Argentina.

"The port engineer and the oil salesmen exptected to hear daily that the *Sherman* had broken down at sea. At best, they expected badly scored gears when she did get into port. But I wasn't worried.

"When Andy Shotski finally received



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- uniform strength and toughness
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No matter how intricate the weld, you do it readily with Youngstown pipe. That's because Youngstown pipe is designed and made for easy welding--truly round, uniform in wall thickness, uniformly sized, and chemically and metallurgically right. The name "Youngstown" rolled into a length of pipe means it is GOOD PIPE.

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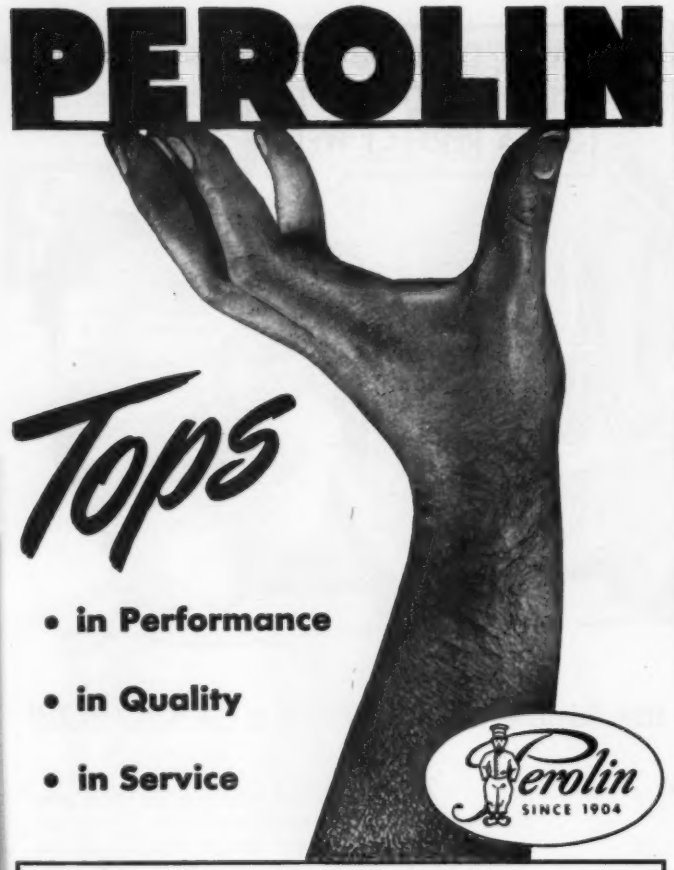

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PEROLIN BOILER TREATMENT...*for Scale and Corrosion Control*

PERO-NITE.....*Soot and Fire Scale Remover*

FORMET WATER TREATMENT.....*Stops Rust and Scale in Water Supply and Air-Conditioning Systems*

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Available everywhere—Write for name and address of nearest representative

the message in Buenos Aires, he went into action. He bought 8000 gallons of oil from a local firm, at $1.75 a gallon. With graft and taxes, that country really puts a price tag on supplies for foreigners.

"He dumped his oil into the fuel-oil settling tank for burning and replaced it with new. Then he flushed new oil through his system for four hours, jacking over his turbine and gears all the time to get rid of the old oil. He then dumped that batch and put in another new charge.

"When the *Sherman* arrived in New York two months after she had left, Shotski was ready to jump down my throat for handing him a lemon. The port engineer felt the same way. The oil salesman, port engineer and I boarded the *Sherman* together.

" 'That's a rotten trick you pulled, Surfaceblow,' croaked Shotski, meeting us on deck. 'With a shipload of displaced persons, you let me plow the ocean with oil not much better than water. That's a criminal offense. There's a place in the jug for engineers like you.'

" 'Before you shoot off your big trap, Chief,' I said to him politely, 'where in hell did you take that sample from?'

" 'From the lube-oil centrifuge, of course,' he answered, surely.

" 'OK,' I answered, 'who took the sample?'

"He thought a minute. 'Why, coming to think of it,' he wheezed, 'I sent one of the wipers for it.'

" 'Get that wiper up here on the double,' I demanded, 'because I'm gonna make you eat your seaboots.' He sent for the wiper.

" 'Where did you get the bottle for that oil sample you took last trip?' I asked the wiper.

He thought awhile. 'I got it from the sickbay,' he answered. 'There was no empty bottles around and the chief told me to pick up the first bottle I saw, fill it with oil, and bring it to the log room so the oil salesman would get out of his hair. Well, I didn't find no empty bottle, so I grabbed a bottle of green liquid soap in the sick bay. I emptied the soap and filled the bottle with oil.'

" 'Did you flush the soap out of that bottle before you put oil in it?' I asked.

" 'No, why should I do that?' he answered in defense. 'The chief said to fill a bottle with oil and that's what I did.'

" 'That explains it,' said the oil salesman. 'There was enough soap left in that bottle to bring the index to 2.0.'

" 'Great sufferin' seagulls!' croaked the port engineer, 'think of all that good oil dumped in Argentina.'

" 'That's right,' I said. '$14,000 dollars burned up just because Shotski sent a wiper to do an engineer's job.' "

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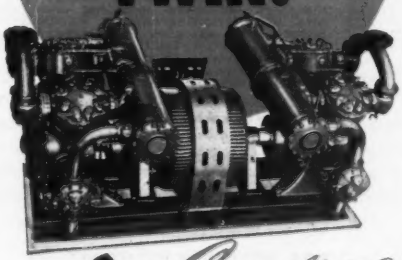
JOY Series 100 compressors are available in two and four cylinder models and in single and twin units. Capacities from 378 to 3656 c.f.m.

UP TO 3656 C. F. M. in a TWIN!



with a JOY PACKAGE TYPE

HEAVY DUTY WN-114 COMPRESSOR

Install it, start it,—then forget it! That's what you can do with a JOY compressed-air power unit, because it's built to give constant, dependable service 24 hours a day, year in and year out. JOY Series 100 Air Compressors are two-stage, double-acting, heavy duty, continuous service compressors—much smaller than old style compressors of the same capacity, yet with operating economies exceeding those of the older, bulkier units. JOY *pioneered* the compact, modern, "package-type" compressor.

All wearing parts are replaceable on the Series 100—the finest air compressors you can put on the job. ● *Let us give you full details on the size that fits your air-power requirements.*

Consult a Joy Engineer

100 Years of Engineering Leadership

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JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

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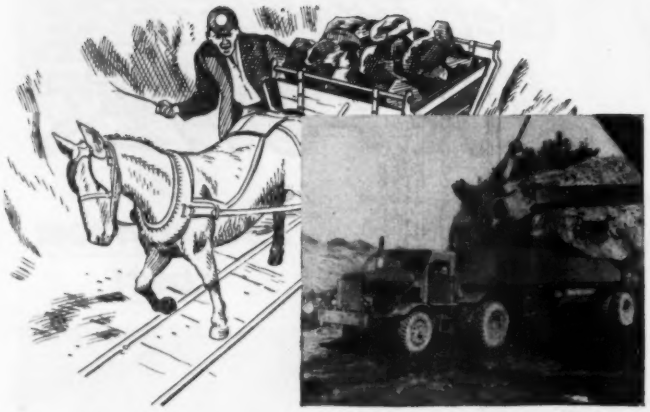

Gone are the mules and primitive mining methods of 1907. Today, Southern's modern mines bring you a wide selection of carefully prepared coals. Symbolic of these changes are giant haulers which carry coal from open pit to preparation plant.

SOUTHERN supplies the right coal to *LOWER YOUR STEAM COSTS*

Right choice of coal is just as vital to your economical steam production as the application of modern machinery is to your specific production problems.

When coal is precisely fitted to the individual requirements of specific types of burning equipment, it invariably steps up boiler efficiency and substantially reduces your steam costs . . . On-the-job surveys and actual burning tests by Southern's fuel engineers have demonstrated this fact in plant after plant.

Southern ships a wide range of precision-sized, uniform quality, scientifically washed coals—a supply continuously reinforced from Southern's vast reserves. Production is big—in excess of 10,000,000 tons annually.

Lower your steam costs. Investigate this modern fuel service. Write, wire or call your nearest Southern office.

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Industrial buyers choose from a wide variety of premium coals efficiently mined and scientifically processed in the coal fields of Western Kentucky, West Virginia, Virginia, Eastern Kentucky, Illinois, Indiana, Alabama, Arkansas and Oklahoma. *One is right for your equipment.*

A TESTED COAL TO MEET EVERY INDUSTRIAL REQUIREMENT

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Sinclair Coal Company, Kansas City 6, Mo.—Western Representative

Boon-Strachan Coal Company, Ltd., Montreal—Canadian Representative

New Free Bulletins

(*Continued from page* 166b)

sions, weights, service factors and hp ratings. Also data on Style R spun metal revolving type and Style P plastic, revolving type protective grease-retaining casings. 4-page folder No. 2363. Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

B29 **VARIABLE SPEED DRIVES** — Covers in condensed form, the three basic units of Reeves variable speed drives—variable speed transmission, Vari-speed Motodrive, and Vari-speed motor pulley—and a wide variety of manual and automatic controls for use with them. 12-page bulletin No. G-509. Reeves Pulley Co, Columbus, Ind.

METALS AND ALLOYS

B30 **CENTRIFUGAL CASTING** — Technical literature presents detailed information on modern techniques of centrifugal casting in permanent molds for improved and expanded production of cylindrical shapes in a variety of alloy steels. Reference tables, drawings, charts, photos. 8-page leaflets. Lebanon Steel Foundry, Lebanon, Pa.

B31 **STEEL CASTINGS** — Booklet "The Steel Casting Industry" lists 7 prime reasons, aside from economy, why all types of manufacturing industries are making increased use of steel castings for many finished products. 34-page booklet. Steel Founders' Society of America, 920 Midland Bldg, Cleveland 15, Ohio.

B32 **STAINLESS STEEL TUBING** — Outlines physical and mechanical characteristics of three non-hardening straight chromium stainless tubing steels—Croloy 12 A1, Croloy 19, and Croloy 27, for mechanical and pressure uses. 4-page bulletin No. TDC 140. Babcock & Wilcox Tube Co, Beaver Falls, Pa.

METERS AND INSTRUMENTS ELECTRICAL

B33 **PRESSURE INDICATOR** — Describes Electronic pressure indicator for measurements of static and rapidly alternating forces, pressures, distances, and vibrations. Accessories include various pick-ups and a synchromarker. 6-page pamphlet No. 525-E. Mogens Bank & Co, P O Box 665, Old Saybrook, Conn.

B34 **WATTHOUR METERS**—Manual shows how electric energy is measured; describes operating principles of alternating-current watthour meters; and explains techniques involved in the use, testing, and maintenance of meters. 40-page manual No. GET-1840. General Electric Co, Apparatus Dept, Schenectady 5, N. Y.

METERS AND INSTRUMENTS MECHANICAL

B35 **DRAFT GAGES** — Portable, stationary and laboratory type inclined draft gages and accessories are described. Tables of capacities, sizes, and prices are also included. 19-page bulletin No. 109. Ellison Draft Gage Co, Inc, 214 W Kinzie St, Chicago 10, Ill.

B36 **RECORDER EQUIPMENT**—Discusses and compares the principles of operation of Micromax and Speedomax speed recorders with supplementary illustrations of recorder installations. Also described a general-purpose instrument which operates in any position at speed up to 2500 rpm. 19-page catalog No. N-27. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

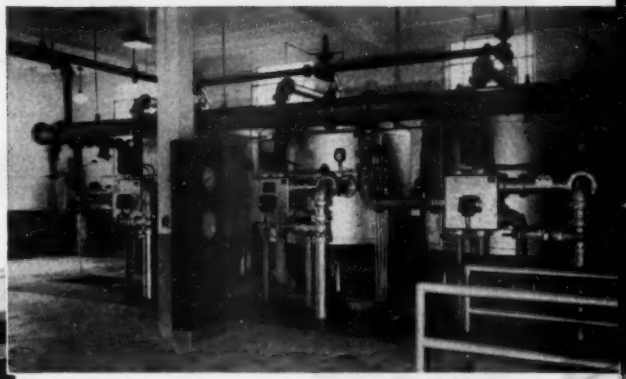
B37 **STATIONARY TACHOMETERS** —Covers the Model J-6 centrifugal type stationary tachometer in standard ranges from 10 to 100 rpm for a minimum and 1000 to 10,000 for a maximum. Designed for permanent mounting on machines or panels. 2-page bulletin No. 794. Herman H Sticht Co, Inc, 27 Park Place, New York, N. Y.

(*Continued on page* 222)

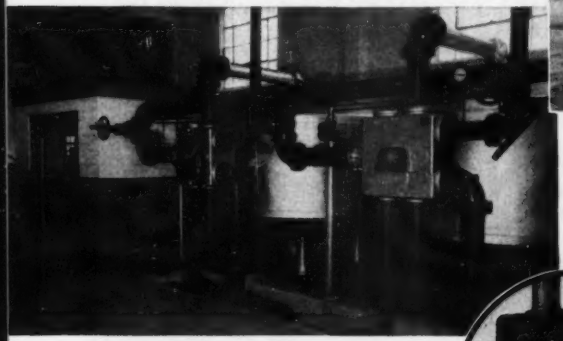
REGENERATED by FATHER NEPTUNE

COCHRANE Zeolite Softeners at City of Jacksonville Beach, Florida

(Right) Cochrane Zeolite Softeners. Three units, each with a 6" Hydromatic Valve, arranged for automatic operation

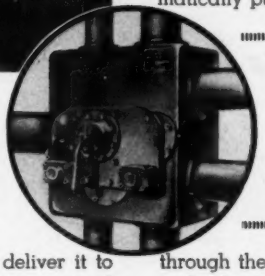


(Below)
Cochrane Sea Water Filters, with 6" Hydromatic Valves



AN interesting example of water softening by Cochrane Zeolite Softeners is that of the City of Jacksonville Beach, Florida, which recently installed a new softening unit as an addition to the city's existing water plant. Three Cochrane Sodium Zeolite Softeners treat aerated raw water from three artesian wells and deliver it to soft water storage reservoirs, from which it is pumped into the distribution system.

The unique feature of the installation is that the regeneration of the zeolite beds does not come from the usual brine tanks, but is accomplished by means of full strength sea water, which is taken from the ocean and, after clarification by two Cochrane filters, is pumped directly to the softener unit being regenerated.



The COCHRANE HYDROMATIC VALVE

This remarkable valve combines, in a single pilot-actuated valve, the functions of six individual gate valves, common to the customary "valve nest". It may be arranged for automatic or manual operation.

The entire plant is fully automatic in its control and in regeneration. Each of the three Cochrane Zeolite Softeners is furnished with a Cochrane 6" Hydromatic Valve, which automatically regenerates the unit after it has softened its rated capacity. The automatic regeneration consists of (1) backwashing, (2) sea water automatically pumped through filters and then downward through the zeolite and out to the sewer, and (3) sea water is rinsed from the zeolite bed by fresh water. After regeneration the unit is automatically returned to service. An electrical interlock prevents more than one unit being regenerated at a time.

The savings effected in the cost of salt and salt handling equipment by using sea water for regeneration makes this a most economical installation, even considering the added cost of piping out into the ocean to secure the sea water.

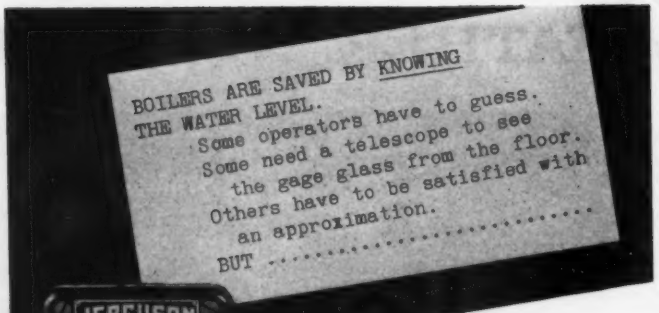
88 YEARS OF SERVICE

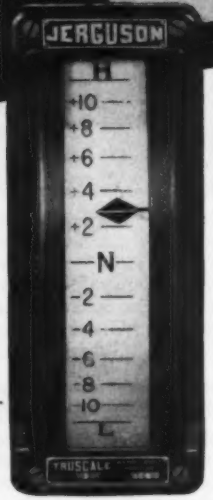
Details and literature may be had on request.

COCHRANE CORPORATION • 3106 N. 17th Street • PHILADELPHIA 32, PA.

In Canada: Canadian General Electric Co., Ltd., Toronto. In Mexico: Babcock & Wilcox de Mexico, S.A., Mexico City. In Europe: Recuperation Thermique & Epuration, Paris.

COCHRANE ZEOLITE SOFTENERS


BOILERS ARE SAVED BY KNOWING
THE WATER LEVEL.
Some operators have to guess.
Some need a telescope to see
the gage glass from the floor.
Others have to be satisfied with
an approximation.
BUT .....



Model #2 duplicates water level as shown in gage glass at boiler

You KNOW
The Water Level
When you have a

JERGUSON TRUSCALE GAGE

THE Jerguson Truscale Gage for remote reading of boiler and other liquid levels is ACCURATE to ½ of 1% of scale reading.

It is DEPENDABLE, for it works on hydrostatic heads directly from the boiler drum. Simple in design, with magnet external to manometer system, and featherlight pointer system. All internal moving parts of stainless steel; no stuffing boxes.

Models for any pressure and range; illuminated dial; scale markings and pointer glow in the dark.

Available with visible and audible alarms at auxiliary points

Marine Operators: *Special installation procedure compensates for roll and pitch of your ship.*

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Phone Listed Under JERGUSON

JERGUSON GAGE & VALVE COMPANY
100 Fellsway • Somerville 45, Mass.
European Mfg. Affiliate: Bailey Meters & Controls, Ltd.

PIPING, FITTINGS, VALVES AND SPECIALTIES

B38 **NON-RETURN VALVES**—Golden-Anderson "Cushioned" single-acting non-return valves. Adaptability, construction, installation, sequence of operation, servicing and specifications are described. 6-page bulletin No. S-2. Golden-Anderson Valve Specialty Co, 2070 Keenan Bldg, Pittsburgh 22, Pa.

B39 **STEAM TRAPS** — Contains revised specifications and capacities on the complete line of Super-Silvertop steam traps, Anderson float traps, air release valves and pipe line strainers. Photographs, sketches, diagrams show trap arrangements, construction and operations. 36-page catalog, entitled "Solving Steam Trap Problems." V D Anderson Co, 1934 West 96th St, Cleveland 2, Ohio.

B40 **VALVE SIZING CHARTS** — A steam valve sizing chart covering the range from 1 to 1,000,000 lbs per hr and a butterfly valve sizing chart covering the range of 15 to 10,000 gpm. Single-sheet form No. 10294. Fischer & Porter Co, Dept, 3940, Hatboro, Pa.

B41 **EXPANSION JOINTS**—Describes Yarway Gun-pakt and Glan-pakt expansion joints. Prices, weights, dimensions, and typical installations are included. 16-page bulletin No. EJ-1912. Yarnall-Waring Co, Mermaid Lane, Philadelphia 18, Pa.

B42 **STEAM CAPACITY CHART** — Steam capacity chart for determining steam capacity required from safety valves to give protection in case of pressure reducing valve failure. Marine & Industrial Products Co, 3731-35 Filbert St, Philadelphia 4, Pa.

B43 **FLOW REGULATING VALVE**—Features Reynolds flow regulating valve for use where the exact setting of regulated flow of water or other liquids is required. Single-sheet bulletin. Reynolds-Shaffer Co, Dept G-56, 12100 Cloverdale Ave, Detroit 4, Mich.

PRIME MOVERS AND ACCESSORIES

★ **2-CYCLE DIESEL ENGINES** — Covers Series 71 2-cycle single and multiple diesel engine units from 2-24 cylinders with power from 32 continuous to 780 intermittent hp. Data on design and interchangeability of parts, power chart, and illustrations given. Catalog. Detroit Diesel Engine Div, General Motors Corp, 13402 W Outer Drive, Detroit 28, Mich. (*Write direct to manufacturer on company stationery giving name and title.)

B44 **4-CYCLE DIESEL ENGINES** — Pictures and describes the 4-cycle, direct injection, totally enclosed DR diesel engines. Photographs, cutaway drawings and specifications included. 18-page bulletin No. S-500-B52A. Worthington Pump & Machinery Corp, Harrison, N. J.

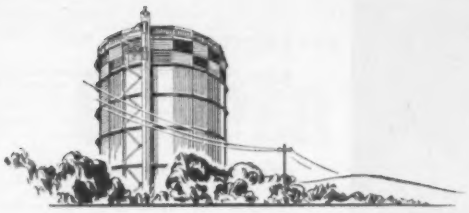
B45 **LOW POWER DIESELS**—Illustrates and describes the Nordberg Type 4FS, 1- and 2-cylinder, 4½-by 5¼-in. diesel engines which are rated at from 10-30 hp at 1200-1800 rpm. 6-page bulletin No. 183. Nordberg Mfg Co, Milwaukee 7, Wis.

B46 **DIESEL ELECTRIC SETS** — Design, operating and performance features of Caterpillar diesel electric sets D397, D386, D375 and D364. Power ranges are outlined, also information on their adaptation for various jobs. 16-page booklet No. 30059. Caterpillar Tractor Co, Peoria 8, Ill.

WATER TREATMENT

B47 **DEMINERALIZER** — Covers the new Penfield permanent cartridge demineralizer for laboratories and other users of up to 10 gph of high purity water. Diagramatic drawing of the unit together with operation and price details. 6-page brochure. Penfield Mfg Co, Inc, 19 High School Ave, Meriden, Conn.

B48 **WATER FILTERS** — Illustrates the heavy-duty construction of Model SC self-cleaning filters designed to filter large volumes of water and



The Harrisburg Gas Co.

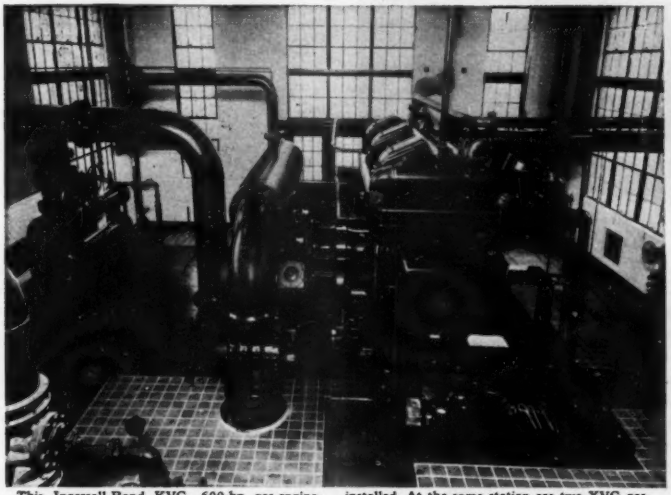
HAS GONE A LONG WAY IN THE PAST 100 YEARS

Erected in 1850 at Harrisburg, Pa., the original plant of The Harrisburg Gas Co. had a maximum output of 25,000 cubic feet per day. Now the company's combined facilities, including a unit under construction, are rated at more than *35,000,000 cubic feet per day!* What's more, growth has continually kept pace with the latest technological advances in the industry. At Steelton, for example, a new catalytic cracking plant has recently been completed—one of the first of its type in the United States.

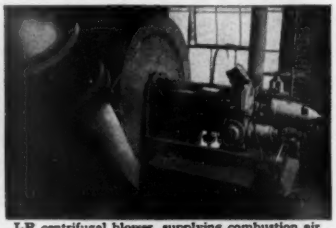
During the past century of progress, The Harrisburg Gas Co. has always placed the emphasis on *continuity of service*, which can be secured only by *quality of construction*. That's one of the reasons why it has repeatedly specified Ingersoll-Rand Compressors and Blowers for all major installations.

The *proved dependability*, operating economy and low-cost maintenance of I-R equipment have become almost a tradition in the gas industry. It took years of experience to build up this reputation—experience in the design, manufacture and application of air and gas handling equipment to meet the rapidly changing needs of the industry. All of this experience is at your disposal—no farther away than your nearest I-R representative.

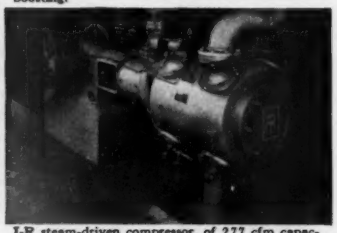
...with the help of dependable I-R equipment like this



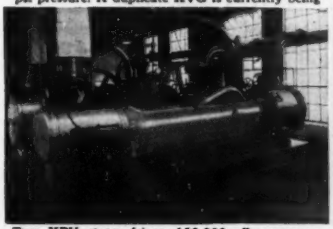
This Ingersoll-Rand KVG, 600-hp gas-engine-driven compressor at the Steelton station can pump 335,000 cubic feet of gas hourly, at 34 psi pressure. A duplicate KVG is currently being installed. At the same station are two XVG gas-engine-driven compressors, each having a capacity of 120,000 cfh.



I-R centrifugal blower, supplying combustion air for oil and gas burners in catalytic cracking furnace. Another I-R blower is used for pressure boosting.



I-R steam-driven compressor, of 277 cfm capacity, supplying process air to the cracking furnace at 20 psi.



Two XPV steam-driven 150,000 cfh compressors handling high-pressure distribution for the Harrisburg station.

Two more I-R steam-driven compressors on high-pressure distribution at Harrisburg. The unit at the right has been in service since 1914.

I-R Type 30 compressor supplying 60-psi air for operating the cracking-plant control instruments.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 570-1

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

Mundet 85% Magnesia Insulation provides attractive smooth finish . . . precise fit . . . maximum strength and resistance to vibration.

New heat saving efficiency is provided by Mundet Custom Molded 85% Magnesia Pipe Covering. Extra durability is built into this insulation. It is precision manufactured on the latest type of automatic equipment to insure uniform standards. It does not "powder", settle or disintegrate. It is unaffected by steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat. You benefit from the most modern manufacturing facilities for the production of heat insulation when you specify Mundet 85% Magnesia Pipe Covering. Write for specification information and recommendations. Mundet Cork Corporation, Insulation Division, 7107 Tonnelle Avenue, North Bergen, New Jersey.

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CHARLOTTE, N. C. 507 S. Cedar St.	**HOUSTON 1** Commerce and Palmer Sts.	**LOS ANGELES** (Maywood): 6116 Walker Ave.	**ST. LOUIS 9** 3176 Brannon Ave.
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other liquids rapidly and at low cost. Typical installations, piping arrangements, full specifications also shown. 6-page bulletin. Sparkler Mfg Co, Mundelein, Ill.

B49 **ION EXCHANGE EQUIPMENT**— Water-conditioning equipment described, including softeners, hydrogen zeolite, de-ionizers and the Ilico-Way mixed-bed de-ionizer. 8-page bulletin No. A. Illinois Water Treatment Co, 899 Cedar St, Rockford, Ill.

B50 **DEIONIZATION** — Folder, entitled "Zero Hardness by Amberlite Deionization" is designed to evaluate the usefulness, applications and recommended layout of ion exchange to provide water almost totally free from hardness, carbon dioxide and silica. 4-page folder. Rohm & Haas Co, Resinous Products Div, Washington Square, Philadelphia 5, Pa.

WELDING

B51 **FITTINGS AND FLANGES** — Data card shows wall thickness and essential dimensions for all types of welding fittings for every nominal pipe size from ⅛ through 30-in. Essential dimensions and bolting data are also given for all types of flanges, in all weights, for nominal pipe sizes from ½ through 24-in. Taylor Forge & Pipe Works, P O Box 485, Chicago 90, Ill.

B52 **STUD WELDING** — Detailed specifications and performance characteristics of two Nelweld power units specifically designed to improve and extend the advantages of stud welding. 4-page folder. Nelson Stud Welding Div, Morton Gregory Corp, Lorain, Ohio.

OTHER EQUIPMENT

B53 **STEEL GRATING AND TREADS** —Explains the properties of Klemp structural steel footwalks, power-forged and riveted open steel grating and treads, Hexteel heavy-duty surface armor, etc. 4-page bulletin. The William F. Klemp Co, 6615 South Melvina Ave, Chicago 38, Ill.

B54 **MAGNESIA INSULATION**—Covers an improved 85% magnesia insulation called Ehret Thermalite, in both pipe covering and block form. Changes and improvements are explained. 4-page bulletin No. 9-0. Ehret Magnesia Mfg Co, Valley Forge, Pa.

B55 **OIL AND WATER COOLER** — Describes a new design oil and water cooler — LK-Fin cooler which uses helically-finned heat transfer elements instead of conventional bare tubes. Selection data, dimensions and specifications for standard sizes are given. 19-page bulletin No. 1020. Griscom-Russell Co, 285 Madison Ave, New York 17, N. Y.

Generators Ordered For TVA's Boone Dam

Three 31,250-kva vertical waterwheel generators will be built at the East Pittsburgh plant of the Westinghouse Elec Corp for the new Boone Dam of the Tennessee Valley Authority. Each of the new generators will weigh about 400 tons. The rotor will be over 25 ft in diameter and its shaft will weigh 375,000 lb.

Built at a total cost of about $2,000,000, the huge generators will stand 12 ft high above the floor and be 38 ft in diameter over the air housing. First unit is scheduled for delivery about July 1952, and all three are to be in operation early in 1953.

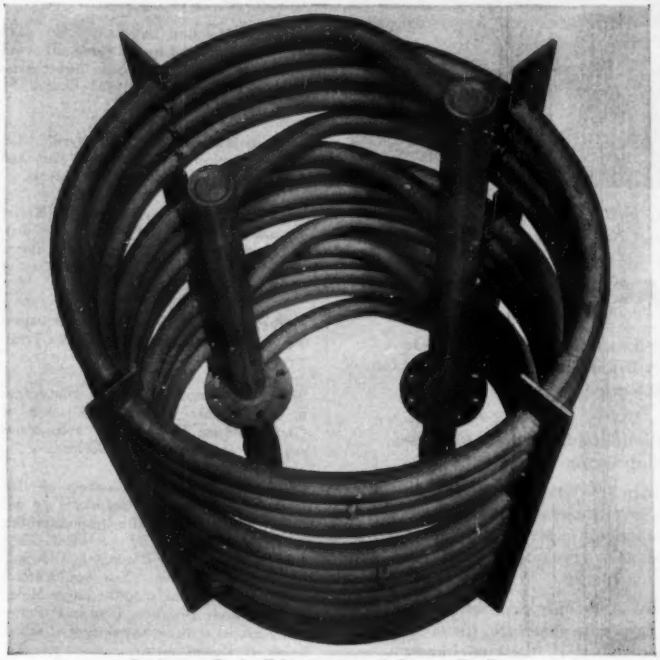
Boone Dam is on South Fork Holston River, near Kingsport and Johnson City, Tenn. The 140-ft high concrete dam will cost about $27,000,000, and the reservoir will contain 211,000 acre-ft of water.

BRIDGEPORT BRASS COMPANY
CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Lead-Copper Duplex Tubes
For Heating Sulphuric Acid Solutions



Lead-copper Duplex Tubing heating coil. Courtesy The Patterson-Kelley Company, Inc., East Stroudsburg, Pennsylvania.

One of the most corrosive liquids widely used in industrial processing is sulphuric acid in various concentrations. Aside from lead no other commercial metal can withstand sulphuric acid under a wide range of conditions for any appreciable length of time. This explains why containers for sulphuric acid solutions are usually lead-lined. Steam heating and cooling coils immersed in sulphuric acid solutions are also generally made from lead.

Lead-Copper Duplex Tubes

Installations of coils made from Duplex Tubing, lead outside with copper inside, have shown some important advantages over lead tubing. The stronger, harder inner tube of copper permits the use of higher steam temperatures and pressures than are practical with the softer and weaker lead tubing. Thus the usable range of temperature and pressure is increased substantially. Furthermore, copper withstands the effects of corrosive steam better than lead.

Lead-copper Duplex Tubing may be used at steam pressures up to 150 lbs. per square inch at 360°F, whereas lead tubing is limited to a maximum of about 50 lbs. steam pressure at 300°F.

Corrosion resistance of lead is generally excellent in sulphuric acid solutions containing up to 50% acid. Lead is also resistant to sulphurous, phosphoric and chromic acids, all of which can be heated or cooled by immersion of lead-copper Duplex heating coils. Lead is also satisfactory for resisting corrosion from wet or dry sulphur dioxide and sulphur trioxide.

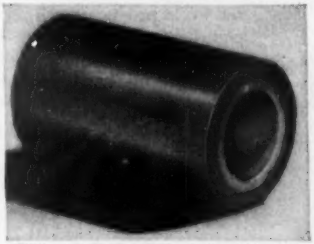
The thickness of the lead component of lead-copper Duplex Tubing is usually ⅛" or more depending upon the severity of the requirements.

Duplex Tubing can be made of several grades of lead, to meet A. S. T. M. specifications. Through the use of high purity lead, maximum corrosion resistance can be obtained. The high purity leads (chemical) are useful up to about 400°F. Antimonial leads, because of their lower melting points, are limited to a maximum of about 250°F.

Joining Duplex Tubes

In making heating coils from Duplex Tubing, it may be necessary to join two or more lengths to obtain the required sizes of coils. Joints are made by cutting back the outer lead component about ½" from each end of the Duplex tubes to be connected. The copper inner tube from one end is expanded by driving in a plug of the proper size so that the expanded end becomes large enough to receive the copper inner tube of the other Duplex tube. The joint is secured by soldering. A thick overlay of lead is wiped on to cover the exposed copper.

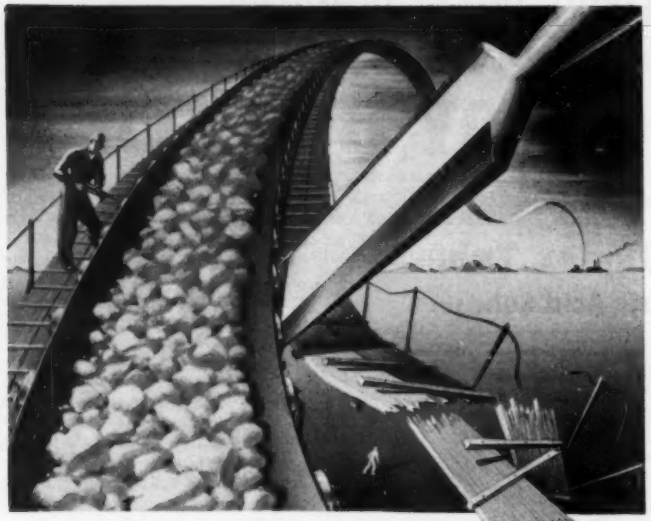
After prolonged service, lead-copper Duplex Tubing coils possess excellent heating transfer characteristics and exhibit superior corrosion resistance.



Bridgeport Duplex Tube—lead outside and copper inside.

There are, of course, many other processing applications for lead-copper Duplex Tubing than for heating and cooling sulphuric acid. Information on various components of metals used in Duplex Tubing, as well as the variety of applications, are published in Bridgeport's "Duplex Tubing Technical Bulletin No. 1950", which will be mailed upon requests made on company stationery. (6542)

(Advertisement)



HOW TO ADD BY SUBTRACTING

SUBTRACT . . . that second walkway. Its sole purpose is to permit lubrication . . . and Hewitt-Robins Idlers are lubricated from one side only. You need but one walkway with a Hewitt-Robins Belt Conveyor.

ADD . . . the dollars you save in initial investment plus the man-hours saved by cutting the lubrication job in half.

You get more . . . and save more . . . when you turn your solid and fluid bulk materials handling problems over to Hewitt-Robins. You get the advantage of longest experience and most advanced design . . . Hewitt-Robins is "famous for firsts" in materials handling methods and machinery.

You save trouble. Hewitt-Robins is the only organization in the world producing, within one corporate structure, the complete belt conveyor package: engineering, specialized machinery *and belting*. Only Hewitt-Robins can accept undivided responsibility for all the elements of a belt conveyor system because *only Hewitt-Robins makes them all.*

The services of our three industrial divisions are yours, individually or collectively, according to your needs.

Next time materials handling is your problem, we invite you to make it ours.

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Executive Offices: 370 Lexington Avenue, New York 17, N. Y.

HEWITT RUBBER DIVISION: Belting, hose and other industrial rubber products
ROBINS CONVEYORS DIVISION: Conveying, screening, sizing, processing and dewatering machinery
ROBINS ENGINEERS DIVISION: Designing and engineering of materials handling systems

Hewitt-Robins is participating in the management and financing of Kentucky Synthetic Rubber Corporation

APPOINTMENTS

J A O'Brien, general manager of Industrial Products Div, becomes vice-president of **Johns-Manville Corp.** Other vice-presidents appointed are: Harold R Berlin, general manager of J-M Building Products Div, and A S Elsenbast, general manager of J-M Celite Div. The new president is L M Cassidy, now also a director of the corporation. Cassidy succeeds R W Lea who retired on Jan 31.

Air Preheater Corp names Benjamin S Kelley sales engineer to represent the firm in Georgia, Florida, and North and South Carolina. His headquarters are in Atlanta, Ga.

Victor P Johnson has joined the sales staff of **Bigelow-Liptak Corp.** He will work out of the company's direct sales and engineering office at 50 Church St, New York City.

Burgess-Manning Co, Libertyville, Ill., announces election of Dudley W Day and C P Certik as company vice-presidents.

Daniel J Lammon succeeds J S Muller as manager of appliance parts sales dept of **Corning Glass Works'** Technical Products Div. Muller is now manager of electronic sales dept.

Cochrane Corp, Philadelphia, has named S B Applebaum manager of its Water Treatment Div.

William R Rogers has been transferred to Philadalphia district sales office of **Carborundum Co** to act as refractories engineer, assisting D W Polhemus.

General Electric Co announces election of three executive vice-presidents to fill newly created posts with responsibilities as assigned by the G-E president. They are: Henry V Erben; Hardage L Andrews; and Roy W Johnson. Their headquarters will be in Schenectady. In the Large Motor and Generator Divisions, George P Patteson is named assistant to manager of sales; Ralph B Bodine is made manager and Robert M Easley, assistant to the manager, large generator and converter sales div. In the Large Apparatus Div, Francis K McCune succeeds Ernest E Johnson as manager of engineering. Johnson is now general manager and Dr Martin A Edwards, engineering manager of general engineering laboratory. William E Johnson replaces McCune as assistant general manager of nucleonics dept. Ralph E Donnelly becomes manager of Fitchburg (Mass.) turbine sales div. Robert G Boulter is appointed manager of sales planning and analysis for Laminated & Insulating Products Div, Pittsfield, Mass.

Carl C Nelson has resigned as vice-president and works manager of **Electric Machinery Mfg Co,** Minneapolis. E Waldemar Sjoquist has been made works manager.

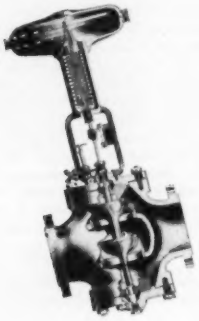
Baldwin-Lima-Hamilton Corp has closed its offices at 120 Broadway, New York City. All sales activities in the New

if you need to control

- FLOW
- TEMPERATURE
- PRESSURE
- LIQUID LEVEL

of

- AIR
- GAS
- VAPOR
- LIQUID
- STEAM



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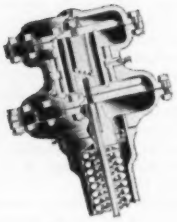

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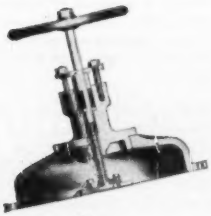

C.

you NEED BS&B "Climax" DIAPHRAGM CONTROL VALVES, Type 86. Here is design and engineering that delivers all the characteristics essential to best process control results. High-lift and characterized inner valves obtain wide rangeability and constant proportional flow increase as valve opens.

Complete versatility is yours. Type 86 Valves are available with reversed topworks (A), duplex diaphragm (B), handwheels (C), finned cooling section, purged gland section, bellows stem packing, steam-jacketed valve bodies and valve positioners. Inner valves are quick-opening, parabolic, V-port, needle and metering pin.

Sizes in double port style ½ inch to 16 inches; single port ½ inch to 4 inches. Pressure ranges are 125 to 5000 psi, within body limits.

Get the complete, detailed story today. Write for new illustrated literature with all the facts on these high-performance Diaphragm Control Valves.

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One significant fact about Green Fan Installations at the New Orleans Public Service Plant is that two different boiler manufacturers were involved . . . two different types of boilers but Green Draft Fans for all three boilers. Each boiler has two Green Induced Draft Fans and one Green Forced Draft Fan.

When a concern has specialized on an important piece of power plant equipment for many years, that firm is rightly called the "authority" on the subject. This is the position of Green Fuel Economizer Co. in the field of mechanical draft fans. The name Green is synonymous with Draft Fans highly acceptable to industry.

The Line of Green Induced and Forced Draft Fans includes many types in many sizes which are described in Bulletin No. 168. We shall be glad to discuss your fan requirements with your own engineers, with your consulting engineers and with the boiler manufacturer of your choice.

THE GREEN *Fuel Economizer* COMPANY INC.

BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

York area will be coordinated in the company's offices at 60 E. 42nd St.

Patrick J Patton is named Milwaukee manager for commercial sales div of **De Laval Steam Turbine Co.** His headquarters are at 1932 N 117th St, Wauwatosa, Wis.

Dearborn Chemical Co, Chicago, announces the following changes in its sales organization: New managers for Eastern Div are C S White, head of water treatment dept, replacing S H Opdyke, retired; and Howard E Johnston, manager of No-Ox-Id sales, replacing C A Remsen who died in January. Both men will make their headquarters in New York. R O Benson succeeds White as sales representative in the Iowa territory. C R Oller returns to San Francisco office. C C Dennis is transferred to Chicago sales staff, replacing Vincent P Nobile who was assigned the New Jersey territory. Further additions to sales staff include R H Derr, Pittsburgh; M H Jamison, T Zaggy, and Paul E France, Chicago; W M Morris, Pennsylvania; and V. E. Stiers, Oregon. Veteran employees retired as of January 1 include B E Conley, Texas; and C I Loudenback and M M Kutzer, Chicago.

New address for **Dowell Inc** in New York is 45 Rockefeller Plaza, Room 1965, New York City.

S W Scott is appointed Pacific district manager for **Graybar Electric Co** with headquarters in Los Angeles. Scott succeeds H L Harper who will retire in April. L J Olivier becomes manager of the firm's New Orleans branch house.

A new Chicago district office has been established by **Hagan Corp** and its subsidiaries, Hall Labs, Inc, Calgon Inc, and Buromin Co. The office is at 1463 Monadnock Bldg, 53 W Jackson Blvd. The Hagan Corp was formerly represented in Chicago by Burke & Colston.

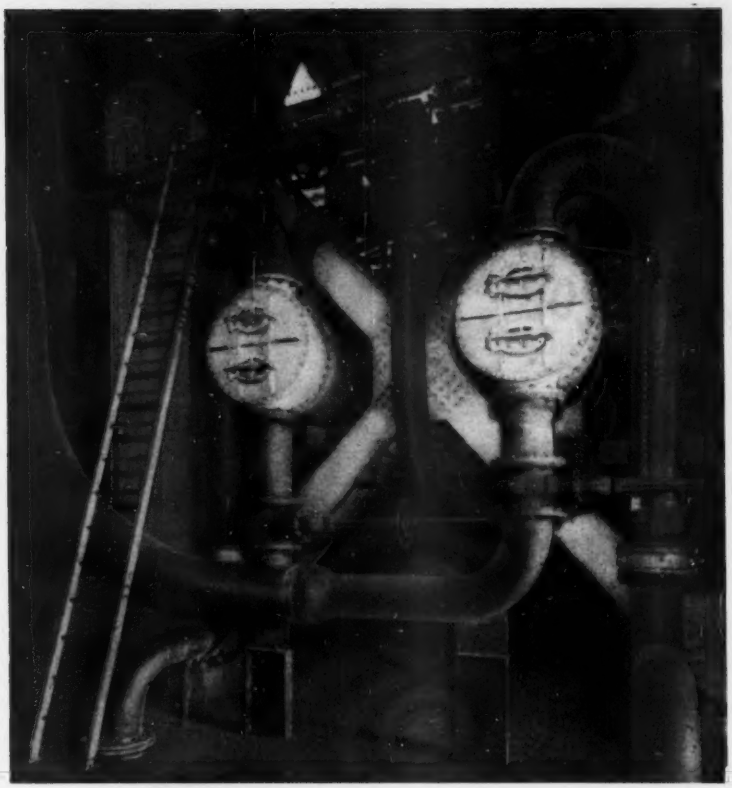
Allis-Chalmers Mfg Co elects William A Roberts president to succeed the late Walter Geist. The following are elected vice-presidents: W C Johnson, executive vice-president for entire company; J L Singleton, vice-president in charge of general machinery div; Fred Mackey, vice-president in charge of manufacturing, general machinery div; R S Stevenson, vice-president in charge of tractor div; A W Van Hercke, vice-president in charge of engineering, tractor div; and John Ernst, vice-president in charge of manufacturing, tractor div. In the firm's Norwood (Ohio) Works, Gerald E Smart is named a plant engineer assisting J J De Windt. Dwight H Lory is assigned to electrical sales and engineering dept at Norwood. Frank R Hunter becomes manager of general machinery div's new branch office in Wichita, Kansas.

Thomas Cornils has succeeded Homer J Foye as chief engineer for **Link-Belt's** Pacific Northwestern Div, with headquarters in Seattle, Wash. Foye has been made chief engineer at the company's plant in Los Angeles, replacing Maurice J

BOILERS

DEAERATORS

EVAPORATORS



CONSECO

CONSECO CONDENSATE COOLERS IN CENTRAL STATION SERVICE

A large Eastern Public Utility recently installed two 1910 sq. ft. CONSECO Condensate Coolers for hydrogen cooling service.

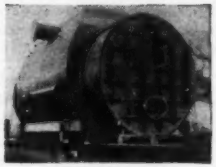
These units are 2-pass fixed head type exchangers operating under critical temperature and pressure drop conditions. Note the large quick-opening doors in channel covers which have been provided for ease in inspection and maintenance.

These units are placed in service during the summer months when condensate temperatures are too high for direct hydrogen cooling.

This Utility chose CONSECO Condensate Coolers not only for the installation shown above but also for two other central stations.

The same engineering experience back of this and all CONSECO equipment is available to assist you in meeting your requirements in Condensers, Ejectors, Evaporators, Coolers, Boilers and Pumps.

STEAM JET AIR EJECTORS



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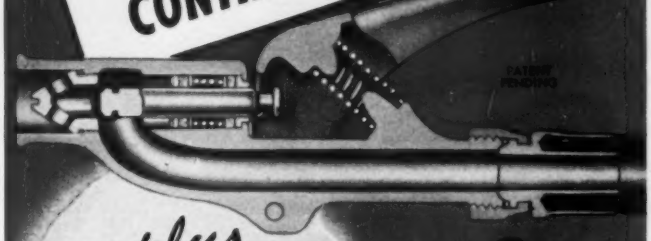
FASTER . . MORE EFFECTIVE FIRE CONTROL

WITH THE ANSUL *Stream Pattern*



. . *plus* BETTER HEAT-SHIELD PROTECTION

Exclusive Features

- Water-tight construction.
- Provides a modified cone-shaped stream pattern without hole in the center of the stream.
- Each nozzle gas pressure tested after assembly.
- Special spring loaded packing to insure lasting water-tightness.
- Designed for use by inexperienced operators.
- Low velocity, more effective streams of dry chemical.

Why Advertise the Nozzle! . . . .

. . . . because the nozzle on your ANSUL Dry Chemical Fire Extinguisher is **water-tight** . . . it won't become inoperative due to corrosion or caking of dry chemical within the working parts . . . the most inexperienced man in your plant can use the **ANSUL extinguisher effectively** . . . and only *Ansul* has a nozzle to meet all of these requirements!

If your hazards require special long range straight stream nozzles, you can get Ansul Extinguishers equipped with these nozzles at no extra cost. With Ansul Dry Chemical Fire Extinguishing Equipment you have not only the best fire protection but also a choice of models and designs to meet your requirements.

Send for File No. 651. You will receive our latest catalog, a Periodic Inspection Record Chart, "Fundamentals of Fire Extinguishment" and information about Ansul Dry Chemical Piped Systems for automatic protection.

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"PLUS-FIFTY" DRY CHEMICAL IS MORE DEPENDABLE ALL-WAYS!

THIS TRADE MARK ASSURES YOU OF QUALITY PRODUCTS

Erisman who has been transferred to Pershing Road plant in Chicago as assistant chief engineer.

Dravo Corp promotes John W Oehler to sales manager of its engineering works div. Morris Hicks becomes manager of Philadelphia district office.

A William Frazer is named Midwest sales manager of **Worthington Pump & Machy Corp** and will direct the sales of Chicago, St. Paul, Kansas City and St. Louis offices from headquarters in Chicago. William F Weinreich is now in charge of the firm's newly acquired Oil City (Pa.) plant as assistant to vice-president Austin C Ross. John Mikulak becomes assistant to L C Ricketts, vice-president in charge of manufacturing at Harrison, N. J.

Dr John F Thompson, president of **International Nickel Co of Canada, Ltd,** has been elected chairman of the board of directors, succeeding the late Robert C Stanley.

Joy Mfg Co announces that Frederick W Thomas is now director of purchases. George R Fox, head of purchasing, becomes assistant vice-president in charge of the company's plant expansion program. Both men are headquartered in the Oliver Bldg, Pittsburgh, Pa.

E O Dixon has been made vice-president in charge of research and metallurgy of **Ladish Co,** Cudahy, Wis. T L Swansen has been named vice-president in charge of manufacturing.

Westinghouse Electric Corp reports the election of new vice-presidents as follows: Tomlinson Fort, manager of apparatus sales dept at Pittsburgh; L W McLeod, Southwestern district manager, St. Louis; Emery W Loomis, Middle Atlantic district manager, Philadelphia; and L E Lynde, who now heads the company's Washington, D. C., government office. In addition, Carroll V Roseberry succeeds R S Kersh as manager of central station dept. Kersh is now manager of the firm's steam division at South Philadelphia, Pa. L D Rigdon is named assistant to vice-president in charge of manufacturing.

The Atlanta branch office of **Mason-Neilan Regulator Co** now occupies new quarters at 805 Peachtree St, N E, Atlanta, Ga.

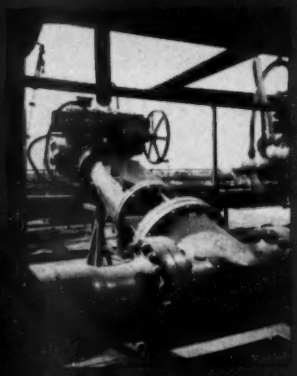
Northern Equipment Div, and **Vulcan Soot Blower Div** of Continental Foundry & Machine Co, have chosen Warriner Equipment Co, 504 Delta Bldg, New Orleans, La., and Hawkins-Hamilton Co, 814 Independence Bldg, Charlotte, N. C., as district representatives.

Thomas B McMeekin assumes duties of George Lienhard who has resigned as sales and service engineer, heavy machinery div, San Francisco office of **Nordberg Mfg Co.**

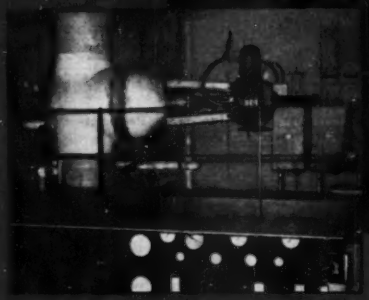
Carl B Bennett joins the field staff of **Resinous Products Div,** Rohm & Haas Co, in the Ohio area. Working out of

another . . .

LIMITORQUE
Advantage



Can be
Mounted
At any Angle



Because LimiTorque Valve Controls are completely mechanical in construction, they can be installed and will function with equal satisfaction, efficiency and dependability in any desired position. No adaptations or compensations are necessary for any angular positioning. There are many valve locations where this LimiTorque feature is not only desirable but vital.

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OIL BURNERS

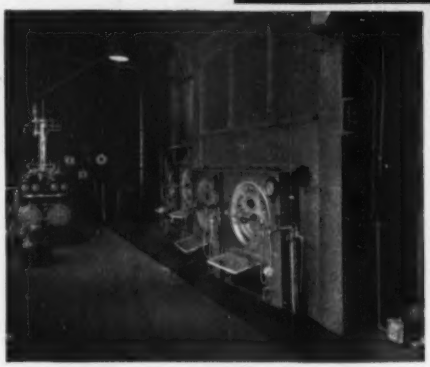
GAS BURNERS & ALLIED EQUIPMENT

for Power and Heat

THESE PICTURES TELL THE STORY!

Before →

A view of boiler room of large Eastern industrial plant before underfeed stokers were replaced with National Airoil Oil Burners.



← After

After installation of NATIONAL AIROIL TYPE S.A. Oil Burners under the four boilers pictured above. Note that lower front walls of the three right hand boilers have been extended. Also note angle fronts to permit firing at high ratings without impingement of flame on side walls. Either forced or natural draft may be used. Total capacity 2800 HP. Large savings were made on stoker and ash handling equipment repairs; brickwork maintenance. One operator now easily cares for all four boilers.

For 39 years—continuously since 1912—NATIONAL AIROIL BURNER COMPANY has devoted its entire efforts to the design, development, manufacture and application of successful Oil and Gas Burning Equipment. This same equipment is used throughout the U.S. and foreign countries. — Many models in varied sizes are available to cover a wide scope of applications and special problems. — Send us details of your plant; our engineering department will gladly offer recommendations.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes: STEAM ATOMIZING OIL BURNERS; MOTOR-DRIVEN ROTARY OIL BURNERS; MECHANICAL PRESSURE ATOMIZING OIL BURNERS; LOW AIR PRESSURE OIL BURNERS; GAS BURNERS; COMBINATION GAS and OIL BURNERS; AUTOMATIC OIL BURNERS, for small process furnaces and heating plants; FUEL OIL HEATERS; FUEL OIL PUMPING and HEATING UNITS; FURNACE RELIEF DOORS; AIR INTAKE DOORS; OBSERVATION PORTS; SPECIAL REFRACTORY SHAPES.

NATIONAL AIROIL BURNER CO., INC.

Main Office & Factory: 1250 EAST SEDGLEY AVENUE
PHILADELPHIA 34, PA.

SOUTHWESTERN DIVISION: 2512 SOUTH BOULEVARD
HOUSTON 6, TEXAS

Cleveland headquarters, he will complement George T Sohl in sales and development work.

Joseph A Holmes has been made a vice-president, industrial dept, of **National Aluminate Corp,** Chicago.

Petro-Chem Development Co appoints Edward J Wasp chief process engineer of its sales division.

Roots-Connersville Blower Corp, Connersville, Ind., elects Robert H Owens to replace the late John Avery as president and general manager. Ralph R Newquist is elected executive vice-president.

Charles Bangert Jr becomes manager of engineering for **Trumbull Electric Mfg Co** in Plainville, Conn. The new district manager of the company's East Central district, is W A Edwards, with headquarters at the Norwood (Ohio) Works. J J Pascher is promoted to district sales manager of New York district.

Wright Chemical Corp has designated Charles W McCumber as St. Louis district manager. With headquarters in St. Louis, he will be in charge of all Wright water-conditioning sales representatives in Missouri, Arkansas, Tennessee, Kansas and the southern half of Illinois.

Dale D Spoor, manager of equipment sales dept, **Air Reduction Sales Co,** has been granted a leave of absence to serve as chief of the welding section, Machinery Div of the National Products Authority in Washington, D. C.

Alloy Steel Products Co, Linden, N. J., names Harold J Bartlett sales manager.

R N Griswold assumes duties of Mid-Central regional sales manager of **American Cyanamid Co,** Calco Chemical Div. He will be located at the Cleveland office, 4500 Euclid Ave.

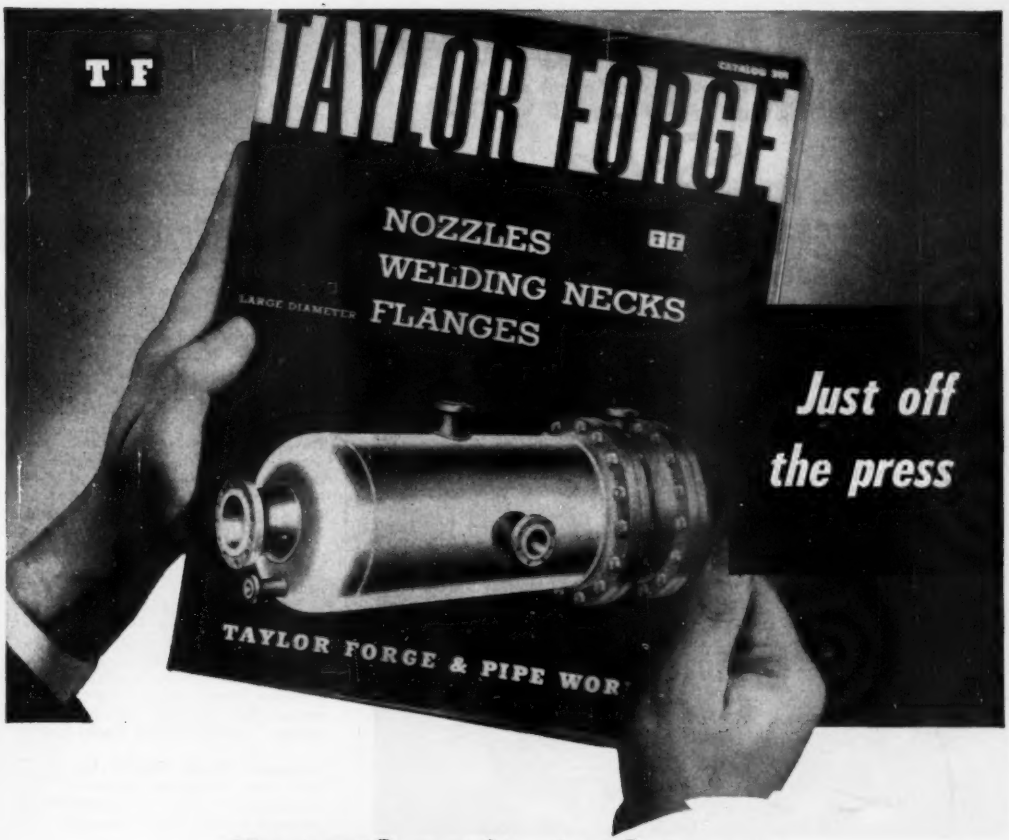
Automatic Switch Co, Orange, N. J., announces election of the following officers: W F Hurlburt Sr, chairman of the board; W F Hurlburt Jr, president; H V Darrin, vice-president and secretary; David M Darrin, vice-president and treasurer.

Lewis P Favorite has been named manager of **Aluminum Co of America's** New York district sales office, succeeding Edward B Wilber, who has been elected president of American Lumber & Treating Co, Chicago.

Homestead Valve Mfg Co appoints Sheffler-Gross Co, Drexel Bldg, Philadelphia, Pa., as its sales representatives.

Alan W Abegglen joins the sales force of the Beaver Falls, Pa., district sales office of **Babcock & Wilcox Tube Co.** David W. Jones, Jr. is made sales agent for the firm in the Rocky Mountain area with headquarters at 2600 Forest Ave, Denver, Colo.

Billings & Spencer Co has chosen C A



Up-to-the-minute data on pressure vessel outlets

IN THIS new Pressure Vessel Catalog 501 you will find the latest data covering pressure vessel outlets compiled as you would expect it to be by the originators of forged and rolled steel welding necks and nozzles.

The pages include up-to-the-minute information on seamless steel nozzles, welding necks, manways, and large diameter flanges for boilers, heat exchangers, and other pressure vessels. Of particularly timely importance are data covering standards of Tubular Exchangers Manufacturers Association (TEMA Standards). A useful section on modern flange design covers codes, materials, and design procedures with typical calculation forms and examples of calculation.

This 118 page book is available without charge to anyone having a specific interest in outlets for pressure vessels. To obtain your copy see your Taylor Forge Distributor or **MAIL THE COUPON.**

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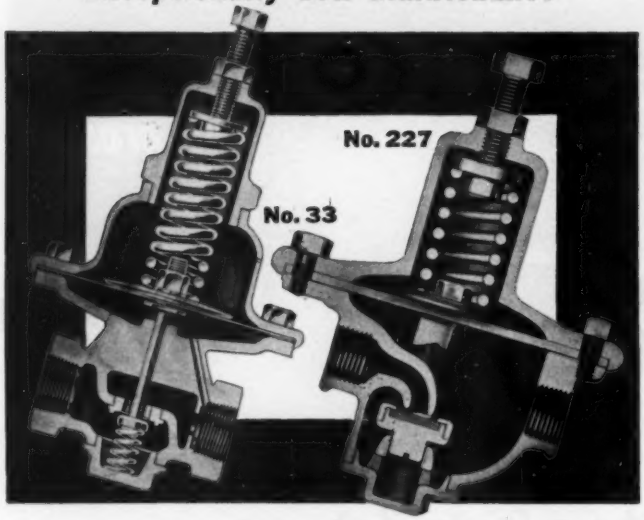
Pressure Reducing Problems with Dependable Operation and Exceptionally Low Maintenance



You can count on Masoneilan Reducing Valves . . . for steam, water and air service . . . to reduce waste, cut costs and save money. That is why production and maintenance men in hundreds of plants use and recommend them. Their experience proves Masoneilan Reducing Valves provide accurate control and require minimum maintenance.

No. 33 **for steam and air service — sizes from ⅛″ to ¾″. Reduced pressure ranges 2 - 20; 20 - 40; 40 - 100 psi. Maximum working pressure 200 lbs.**

No. 227 **for water service — sizes ¼″ to 2″. Reduced pressure ranges between 10 and 60 psi. Maximum working pressure 150 psi. Also available for air service from ¼″ to 1″.**

Masoneilan Strainers protect pressure regulators, shut-off valves and other apparatus from damage by keeping out dirt, chips and other foreign matter.

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Wagner as its representative for Texas, Arkansas, Louisiana and Oklahoma with headquarters in Dallas.

John W Nestor succeeds the late M A Dibble as assistant manager of Finishes Div, **Du Pont Co,** Wilmington, Del. Joseph B Dietz becomes assistant director of sales, and William P Fisher replaces him as manager of industrial sales.

Conoflow Corp has selected J R Simpson & Co, 600 S Michigan Ave, Chicago, as representative in Illinois, Indiana, and Wisconsin.

Grant C Woodard is added to field sales and engineering staff of **Cooper-Bessemer Corp.** He will directly assist C J Michelson who at present represents the firm in the territories of Michigan, Ohio, West Virginia, Kentucky and Tennessee.

Davey Compressor Co, Kent, Ohio, names Ernest S Theiss chief engineer of the company.

Greer Hydraulics Inc appoints Harold E Webb, 918 N Kenilworth Ave, Glendale, Calif., as its West Coast sales and service representative.

T E Woodruff succeeds D T Johnstone as manager of Pump Div, **Fairbanks, Morse & Co,** with headquarters in Chicago. Johnstone assumes duties of pump dept manager of the company's San Francisco branch house. Orren S Leslie replaces Henry M Haase who resigned as manager of Beloit (Wis.) Works.

Industrial Sound Control Inc, Hartford, Conn., has named Richard D Lemmerman vice-president in charge of engineering, research and development.

Betz Engrg Sales Co, 1225 Magazine St, New Orleans, La., will represent **Hilliard Corp** in the territory of Louisiana, Mississippi, and southern Arkansas.

Independent Pneumatic Tool Co reports the following personnel changes: John B Dempsey is named manager of Detroit branch, succeeding Robert G Faverty, who is now managing director of Armstrong-Whitworth & Co, Pneumatic Tools, Ltd, new Thor subsidiary in England. Edward W Krantz replaces Dempsey as Pittsburgh manager. William J McGraw succeeds Krantz as manager of New York branch. Clarence B Bergren is now Cleveland branch manager replacing McGraw.

W B Phillips has succeeded Edward J Waring, who retired, as president of **Pyrene Mfg Co,** Newark, N. J.

Lac'ede-Christy Co, Chicago, announces election of the following officers: D N Watkins, president, treasurer, and general manager; A B Agnew, vice-president; J L Cummings, vice-president; L C Hewitt, vice-president; E J Williams, controller and secretary; J H Schoemaker, assistant secretary; R G Jones, assistant treasurer.

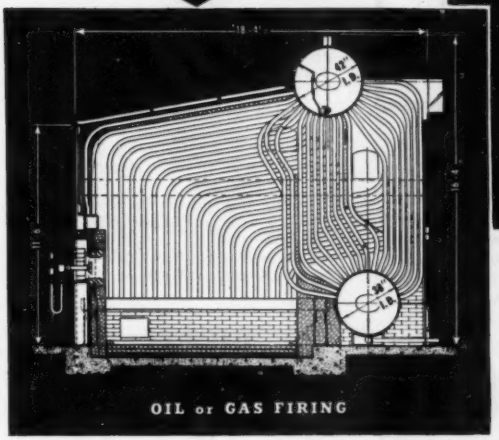
Wenzel A Lindfors becomes factory representative for **New York Belting & Pack-**

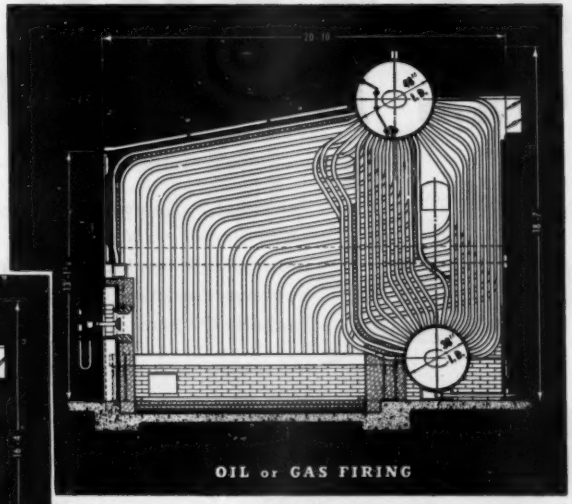
WHICH V-C Meets Your Needs?

Both are High Capacity 2-Drum Water Tube Boiler Units for Limited Space....

3 V-C

This series with 42" top drum—17 tubes deep thru the main boiler bank, has integral water cooling in front, sides and top. A selection of 17 standard sizes available in widths from 5'-2" to 17'-2" and heating surfaces from 1394 to 5426 square feet.





4 V-C

This series with 48" top drum—19 tubes deep thru the main boiler bank—has integral water cooling in front, sides and top. A selection of 17 standard sizes available in overall widths from 5'-2" to 17'-2" and heating surfaces from 1850 to 7245 square feet.

WRITE for Erie City Bulletin SB37A containing complete engineering data for Types 3 V-C and 4 V-C 2-Drum water tube boilers for spreader stoker, underfeed stoker and oil or gas firing. Investigate this steel cased, completely water cooled steam generator which incorporates modern ideas in a compactly designed high efficiency unit.

COMPLETE STEAM POWER PLANT EQUIPMENT

ERIE CITY

Complete Steam Generators • Type C 3-Drum Boilers • Types VL & VC 2-Drum Boilers • "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • "Keystone" Packaged Steam Generators • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

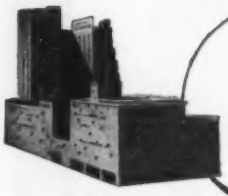
ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*

SPENDS $82,000 SAVES $94,718

the first year

WITH

PEABODY OIL BURNERS



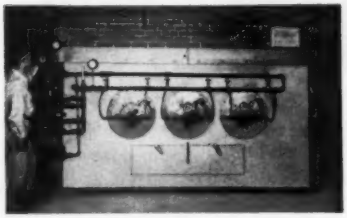
The Hotel St. George in Brooklyn *saved the cost of the entire installation* **in less than one year by converting from coal to Peabody Oil Burners.**

Before . . .

The St. George Hotel used 17,000 tons of bituminous coal a year to fire four 400-HP boilers operated at 75% efficiency. Conversion to oil was based on records dating back to 1928 and included *all* costs of operation.

After

Dirt and dust, along with coal bins and stokers, ash removal problems and maintenance expense, together with high labor costs, have been eliminated by Peabody oil burning equipment that fires these same boilers at 81% efficiency!



PEABODY PRODUCTS INCLUDE: *Automatic Gas and Oil Burners • Pump and Heater Sets • Direct Fired Air Heaters • Gas Scrubbers, Coolers and Absorbers • Burners, singly or in combination, for firing Oil, Pulverized Fuel, and Gas (manufactured, natural, refinery or blast furnace).*

509

OFFICES IN PRINCIPAL CITIES

PEABODY ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N.Y.
Manufacturers of all types of combustion equipment, direct fired air heaters, gas scrubbers, coolers, and absorbers

ing Co in Minnesota, northwest Wisconsin, North and South Dakota and northern Iowa. He will make his headquarters with W S Nott Co, Minneapolis, distributors for the firm.

A G Postlethwait has been made vice-president of **Lord Mfg Co,** Erie, Pa. Also, a field office has been opened in Dallas, Texas, at 1613 Tower Petroleum Bldg.

Okonite Co, Passaic, N. J., names E D Youmans to replace D R Stevens, who is retiring, as vice-president in charge of manufacturing and research.

Maury E Bettis Co, 3319 Gillham Rd, Kansas City, Mo., has been chosen as industrial and electronic sales representative for **Ward Leonard Electric Co** in the Kansas City area.

Richardson-Allen Corp has established a Canadian company, Richardson-Allen of Canada, Ltd, at 370 Victoria St, Toronto, with Wesley S Block Jr as president and Cecil E Brigham, vice-president. Operations will be under direction of Kergen Wells, secretary.

Anthony J Zino Jr is now assistant to the president of **Swan-Finch Oil Corp,** New York City.

Herbert B Nechemias succeeds J S Smith as manager of industrial sales dept of **Wagner Electric Corp,** St. Louis, Mo. Smith is named director of purchasing.

Wheelco Instruments Co has appointed Ansell & Goda, 3432 Connecticut Ave, N W, Washington, D. C., as district agency for the territory including District of Columbia, Virginia and part of Maryland.

OBITUARIES

Walter Geist, 56, president of Allis-Chalmers Mfg Co, Milwaukee, Wis., died suddenly Jan 29 of a heart ailment.

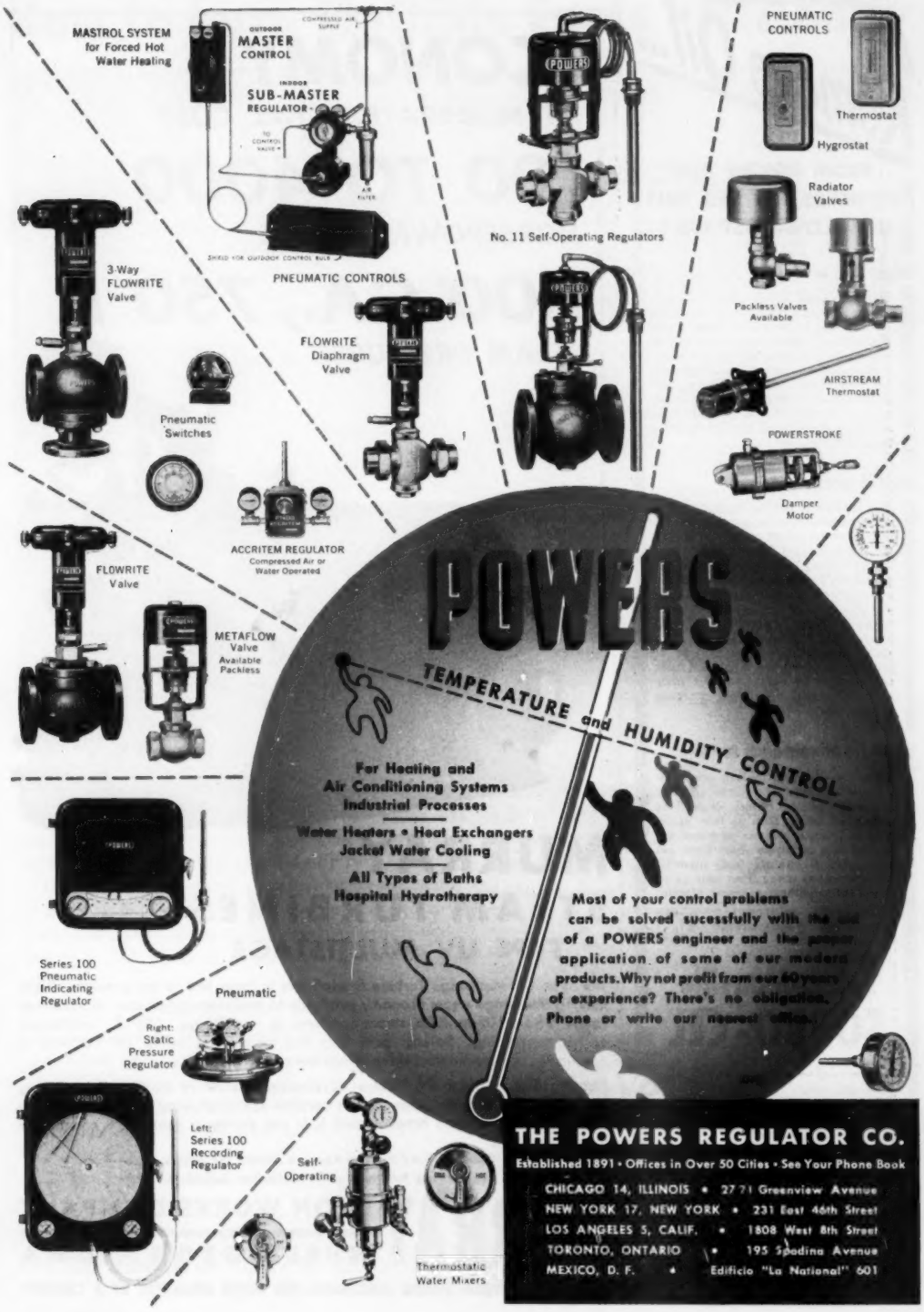
Robert Crooks Stanley, 74, chairman of the board of directors of International Nickel Co of Canada, Ltd, died Feb 12 at his home in the Country Club Grounds, Dongan Hills, Staten Island, N. Y.

Glenn W Christopher, 64, manager of standard pipe sales for Youngstown Sheet & Tube Co, died Feb 13 in a Youngstown, Ohio, hospital after an illness of a year.

Russell L Peck, refractories engineer for Norton Co, was killed Jan 2 in an automobile accident in Tallulah, La.

Albert R Granger, 76, retired vice-president of Philadelphia Electric Co, died Jan 31 after a long illness at his home in Cape May, N. J.

John Avery, president and general manager of Roots-Connersville Blower Corp, Connersville, Ind., died unexpectedly Jan 13.


MASTROL SYSTEM for Forced Hot Water Heating
OUTDOOR MASTER CONTROL
INDOOR SUB-MASTER REGULATOR
PNEUMATIC CONTROLS
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PNEUMATIC CONTROLS
Thermostat
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Radiator Valves
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AIRSTREAM Thermostat
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Damper Motor
3-Way FLOWRITE Valve
Pneumatic Switches
FLOWRITE Diaphragm Valve
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Compressed Air or Water Operated
FLOWRITE Valve
METAFLOW Valve Available Packless
POWERS
TEMPERATURE and HUMIDITY CONTROL
For Heating and Air Conditioning Systems Industrial Processes
Water Heaters • Heat Exchangers Jacket Water Cooling
All Types of Baths Hospital Hydrotherapy
Most of your control problems can be solved sucessfully with the aid of a POWERS engineer and the proper application of some of our modern products. Why not profit from our 60 years of experience? There's no obligation. Phone or write our nearest office.
Series 100 Pneumatic Indicating Regulator
Pneumatic
Right: Static Pressure Regulator
Left: Series 100 Recording Regulator
Self-Operating
Thermostatic Water Mixers
THE POWERS REGULATOR CO.
Established 1891 • Offices in Over 50 Cities • See Your Phone Book
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LOS ANGELES 5, CALIF. • 1808 West 8th Street
TORONTO, ONTARIO • 195 Spadina Avenue
MEXICO, D. F. • Edificio "La National" 601

Remove Oil...

FROM BOILER AND PROCESS WATERS THIS NEW LOW-COST WAY!

What it is —

Filtration with Sorbo-Cel is a simple, low-cost method of removing emulsified oil from water. In plants using steam generating equipment, it is proving an especially effective and economical means of obtaining oil-free condensate for boiler feed. It also provides a practical solution to other oil-contaminated water problems, such as the water used in pumps, condensers, cooling systems, moving driers, etc.

How it works —

The method is similar to that used in other conventional industrial filtration operations. A small amount of Sorbo-Cel (a specially processed diatomaceous silica powder), is added to the water to be filtered. This is then pumped through a pressure filter where the oil globules are adsorbed by the specially treated Sorbo-Cel particles. Both are retained on the filter screen, the filtered water alone passing through. Any type of pressure filter having a metal screen and capable of operation at a pressure differential of 30 psi or more may be used.

What its advantages are —

Sorbo-Cel filtration is fast, economical and efficient. It assures virtually complete removal of oil, as well as suspended solids such as rust, scale, clay, etc. Large volumes of water are filtered in a relatively short time, yet total costs (including both material and operation) range from only 1¢ to 3¢ per 1000 gallons of water filtered.

For further information about Sorbo-Cel filtration use the coupon below.

Johns-Manville

SORBO-CEL

Johns-Manville
Box 290, New York 16, N. Y.

Send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

Company_____

Address_____

City_____ State_____

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ECONOMY

AT MODERATE INITIAL COST

100 TO 4000

HORSEPOWER RANGE

600# GA., 750° F.

STEAM PRESSURES

MURRAY

STEAM TURBINES

TYPE UV MULTISTAGE

The Type UV Multistage Turbine is available in from two to ten pressure stages making Multistage steam economy available at moderate initial cost. Horsepower range is from 100 to 4000, steam pressures up to 600# ga., 750° F., condensing or non-condensing. Several governors and accessories adapt UV Turbines to practically any mechanical drive within the capacity range.

Pictured is a 5 Stage UV Turbine developing 325 HP at 6200 RPM operating condensing. Turbine is equipped with variable speed oil relay governor, pressure lubrication and vacuum breaker, and is in use driving a centrifugal compressor for refrigeration.

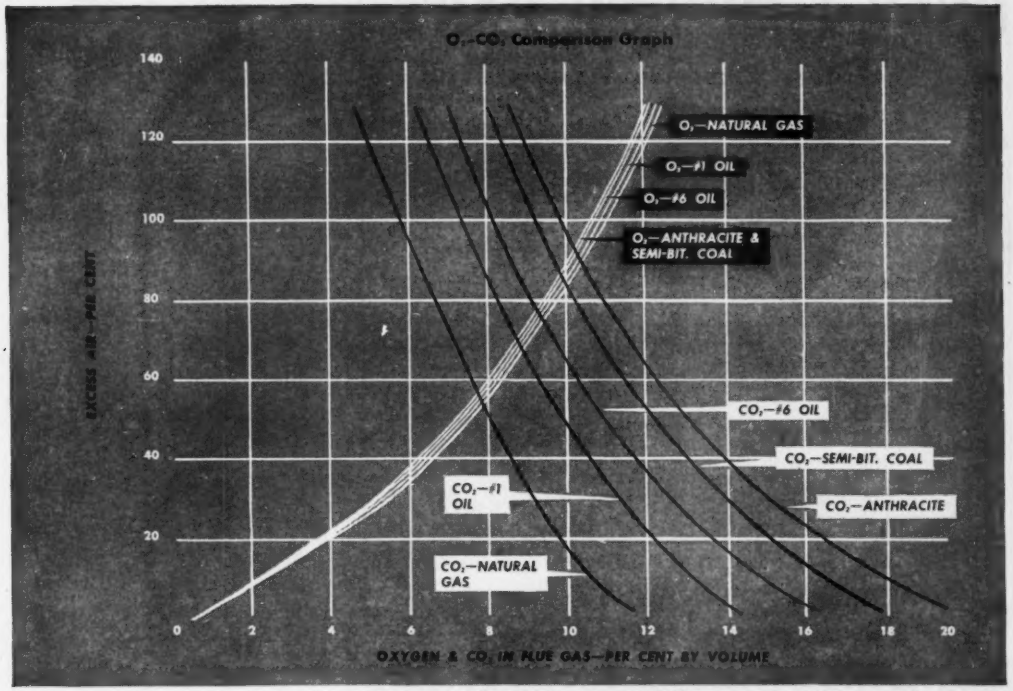
Contact your Murray representative for prices and engineering information or write for Bulletin T-122.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

How to burn Multiple Fuels efficiently



Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

When switching from one fuel to another or burning more than one fuel at the same time, you can realize large savings with a continuous indication of Oxygen content in your flue gas—because Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

This fact is borne out by the graph showing the relationship of excess air to CO_2 and O_2 in the flue gas of five common fuels. While the O_2 curves nearly coincide (especially in the important 30% excess air range) the CO_2 curves diverge widely.

Large Savings Possible

This deviation was costing a medium sized refinery in Michigan $35-40 per day in boiler room fuel costs. Burning a combination of oil and gas they found that a combustion control system to handle their multiple fuel firing conditions would cost more than their small boilers.

They purchased a Hays Magno-Therm Oxygen Recorder, and immediately found that their boiler operation was so inefficient that the pen would not stay on the 0-10% chart. However, by operating with reference to the O_2 recorder they were able to reduce fuel costs enough *to pay for the instrument in 40 days.*

With the Hays Magno-Therm Oxygen Recorder you get:

Continuous, highly accurate indication and recording.
Complete compensation for temperature and pressure effects.
Freedom from chemicals or hazardous fuel burning in the analyzing process.
Swift, sure electronic operation.

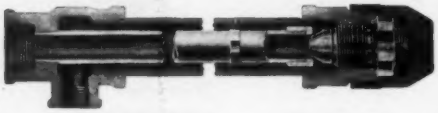
If you are facing the problem of multiple fuel combustion, you will want a detailed copy of this O_2-CO_2 Comparison Graph as well as Hays Bulletin 50-829—describing the Magno-Therm Oxygen Recorder. Write for this free information.

THE HAYS CORPORATION
MICHIGAN CITY 3, INDIANA

Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

ONLY 1 MOVING PART

in Nicholson Expansion Steam Traps



There is not a pin, not a bearing, not a link, nor a lever to wear in this Nicholson expansion steam trap. The valve is the only moving part. This extreme simplicity is resulting in remarkably low maintenance costs. There are hundreds of instances of traps in continuous service for as much as two years without even a sign of valve cutting.

Remarkably Low Maintenance Costs Shown on Many Varied Installations

Appreciable fuel savings are also being effected. Traps are easily adjusted to pass condensate at any temperature below 212°F, instead of at near steam temperature.

Easily installed, often without supports. Lengths, 18" to 40". Pressures, 0 to 250 lbs. No air binding.

FOR ALL EQUIPMENT
Using Steam or Hot Water

Radiators	Dry Kilns
Separators	Vulcanizers
Paper Machinery	Switch Heaters
Pipe Coils	Laundries
Kettles	Plastic Molding
Railway Coaches	Presses

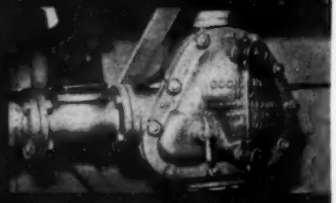
Catalog 250 or see Sweet's

W. H. NICHOLSON & CO., 125 Oregon St., Wilkes-Barre, Pa.

COCHRANE MULTIPORT DRAINER

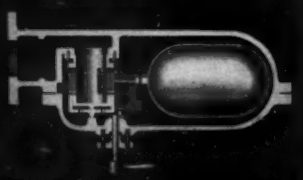
(Continuous Flow Steam Trap)

CONTINUOUS DRAINAGE of low pressure condensate and HIGH DISCHARGE CAPACITY are features of the Cochrane Multiport Drainer that have made these continuous flow steam traps popular the world over.



Balanced Rotary Valve and large port areas permit instant response to great discharge demands. Valve opening is determined by height of water in float chamber. As volume of water increases, the larger the valve opening becomes.

Other features: Valve never leaves its seat and is self-cleaning. Inlet at top prevents possibility of trap becoming air bound. Rotary Valve Seat is attached directly to float stem, one moving element. Write for Publication 4340.

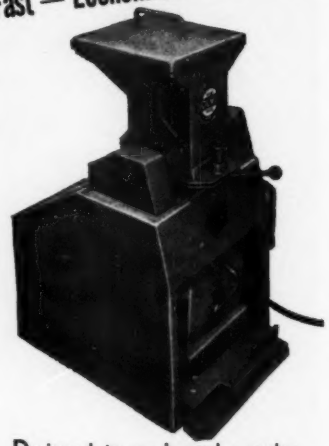


COCHRANE CORP., 17th ST. & ALLEGHENY AVE., PHILADELPHIA 32, PA.

Holmes

Coal Sample Crushers

Fast — Economical — Uniform



Designed to crush coal samples for testing. Produces samples of uniform size consist for constant and accurate analysis. Holmes' Laboratory Crushers feature easy accessibility to crushing chamber for cleaning, replacing hammers, and changing screens. Rubber seals climinate dust leaks. High crushing rate, low initial and operating costs are outstanding.

Simplified — Accurate Coal Sample Grinding with Holmes Pulverizers

Dustless operation. Rugged and compact construction with quick opening feature for easy cleaning. None of the sample is lost. High grinding rate with negligible over-size material. Even, constant feed maintained by easy-turning screw-feed. Grinds 20-mesh material down to small micron sizes.

ROBERT HOLMES
AND BROTHERS, INC
DANVILLE, ILLINOIS
Dept. D-1

TO COMBAT HIGH PRESSURE SUPERHEATED STEAM OR HOT GASES

specify . . . ANKORITE #804

THE ANCHOR PACKING CO.

STAYS SOFT AND RESILIENT IN SPITE OF HEAT

"Ankorite" # 804 is the ideal packing to use against high pressure, superheated steam or for hot and dry gases.

Its construction is something special: Pure asbestos, graphite plastic core having an outer jacket of closely braided high quality asbestos yarn reinforced with Monel metal wire. It will *stay soft* against high pressure and high temperature.

"Ankorite" # 804 is furnished in spirals, coils and ring form—packing sizes ¼" up to 1¼". Also in sets of die-formed conical shaped rings, where specifications permit.

ITS USES: VALVE STEMS . . . THROTTLE VALVES . . . CONTROL VALVES . . . EXPANSION JOINTS . . . FURNACE DOORS . . . AUTO CLAVES . . . AND MANY OTHER USES!

Write today for full details.

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How a manufacturer cut costs tremendously with Goulds stainless steel pumps . . .

When handling corrosive liquids, pumps alone can be an important item in your processing budget. One alert plant engineer in the southwest cut his pump costs to about an eighth of what they had been.

The pumps he had been using for an especially erosive crystaline slurry cost $3250. When they wore out he replaced them with Goulds Stainless Steel Centrifugals for only $826. But this tremendous saving in initial cost was only half the pay-off. The Goulds pumps have already been in service *twice as long* as the ones they replaced . . . and they're still going strong.

The advanced design and simple construction of Goulds pumps make these savings possible. Bearings are prelubricated and fully protected. Stuffing boxes are under suction pressure to prevent leakage and assure long packing life. Parts are interchangeable. The impeller clearance can be adjusted for wear. Available in 9 sizes with capacities to 750 G.P.M. Send us the coupon today for full details.

Goulds PUMPS INC. Seneca Falls New York

GOULDS PUMPS, INC.
Dept. PO, Seneca Falls, N. Y.
Send Bulletin 725.3 on Goulds Stainless Steel Centrifugal Pumps.

Name_____
Company_____
Address_____
City_____ Zone____ State____

MORE POWER TO YOU . . .

Lower operating costs
Lower fuel consumption

If keeping pace with increased demands for more power has taxed your present plant facilities to capacity, call on a Ferguson First Team—qualifed power plant engineers, designers and builders—men who work efficiently together and *with your organization* — men who know your problems, have solved similar ones for others.

Ferguson is aware that individual problems must be treated as such—therefore thorough preliminary investigations are made in the light of plant modernization, renovation of existing facilities, or the need for completely new construction to affect efficient, economic operation.

Careful consideration *is given to basic power plant design so as to facilitate a progressive expansion program.*

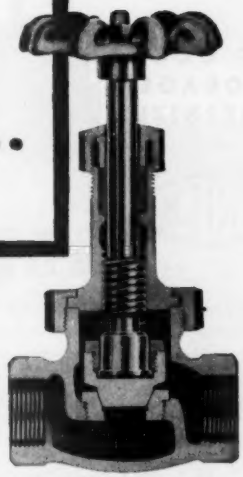
THE H. K. FERGUSON COMPANY
ENGINEERS AND BUILDERS

Headquarters:
Ferguson Building, Cleveland, Ohio

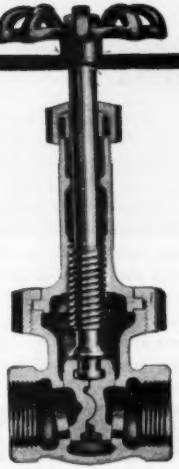
District Offices:
New York, Houston, Chicago, Los Angeles, Cincinnati

PRELIMINARY DISCUSSIONS IN CONFIDENCE and WITHOUT OBLIGATION

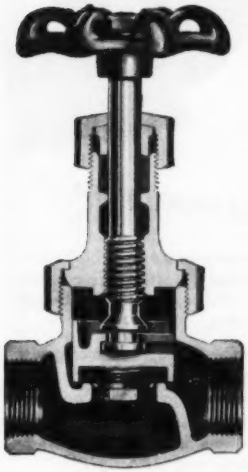
Walworth bronze valves...



Walworth No. 225P Globe Valve
500 Brinell Seat and Disc



Walworth
No. 29 Gate Valve



Walworth No. 95 Globe Valve
Re-New-Disc

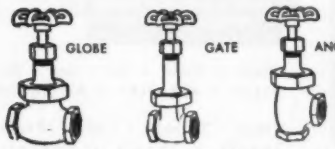
built to give dependable trouble-free service on all recommended jobs

Walworth No. 95 Bronze Globe Valves (Angle Type: No. 96) are recommended for service where throttling is not required. They are rated at 150 psi working steam pressure, 500F; 300 psi cold water, oil or gas. The improved renewable disc and lock-on, slip-off disc holder — an original Walworth development—saves time and trouble. This valve can be repacked under pressure when fully opened. All parts are designed to give maximum service and strength.

Walworth No. 29 Bronze Gate Valves are rated at 200 psi working steam pressure, 550F; 400 psi cold water, oil and gas. These valves have rising stems and integral seats. Sizes 2-inch and smaller have union bonnets; sizes 2½ and 3-inch have bolted bonnets. Valves up to and including ¾-inch have solid wedge discs; 1-inch and larger have split wedge discs. These valves can be repacked under pressure when fully opened.

Walworth No. 225P Bronze Globe Valves (Angle Type: No. 227P) are rated at 350 psi working steam pressure, 550F; and 1000 psi non-shock service on cold water, oil and gas. The stainless steel, plug type seat and disc — heat treated to 500 Brinell — can be closed on sand, slag, scale and similar floatage, without injury to the seating surfaces. They are the longest wearing, TOUGHEST bronze valves you can buy.

For full information about Walworth Quality Bronze Valves, see your Walworth distributor, or write:



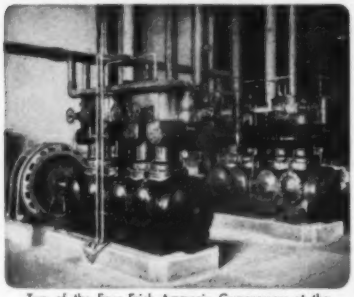
WALWORTH
valves and fittings

60 EAST 42nd STREET NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

BIG COLD STORAGE MODERNIZES with FRICK Refrigeration

The three buildings of the Philadelphia Warehousing and C. S. Co. occupy a city block along the Delaware River water-front. Until recently the cold storages were cooled with steam-driven refrigerating machines installed in 1890 and 1911.



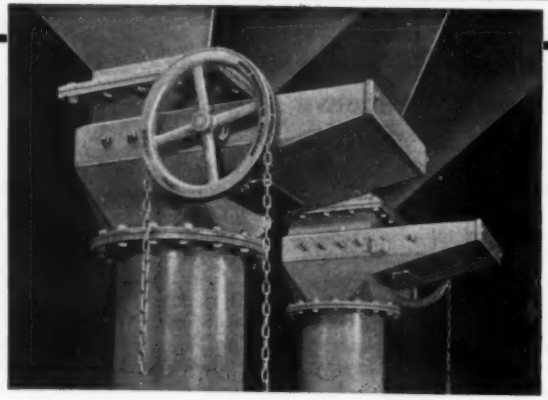
Two of the Four Frick Ammonia Compressors at the Philadelphia Warehousing and C. S. Co.

Today the cooling load is carried by four new Frick compressors, driven by electric motors totaling 775 hp. A battery of large shell-and-tube brine coolers were included in the modernization program.

Let us submit estimates on the up-to-date cooling equipment you may need: write, wire, phone or visit

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO PENNA. U.S.A.

Also Builders of Power Farming and Sawmill Machinery



S-E-CO. COAL VALVES have dust-tight construction. Valve bodies are welded into one unit from heavy steel plate. Access openings are closed with heavy, gasketed covers. For a clean boiler plant, use S-E-Co. Coal Valves.

Write for Bulletin

STOCK EQUIPMENT COMPANY
715P Hanna Building ★ Cleveland 15, Ohio

BELMONT 19... for hot and cold water rods and plungers, low and intermediate steam rods.
BELMONT 30... for high pressure steam rods, expansion joints, air and gas.
BELMONT 6102... for rod and valve stems handling volatile distillates.
cut equipment "down-time" with...
BELMONT PACKINGS

BETTER SEALING...LONGER LIFE

• Idle equipment affects production schedules . . . influences product quality and many times cuts deeply into profits.

To keep equipment producing, use Belmont, the Packings that have individual characteristics and are scientifically designed and constructed by packing specialists to seal better and last longer.

Easy to get . . . Belmont Packings are stocked by local distributors in every large industrial center. Or, if you have a problem that requires special engineering attention, write direct.

Catalog #40 is available, write for it.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

THE BELMONT PACKING AND RUBBER CO.
Butler and Sepviva Streets
Philadelphia 37, Pa.

Steam • Water • Oil • Gas • Air
Acids • Alkalies • Ammonia

Rings • Spirals • Coils • Reels
Spools • Sheets • Gaskets

SANTOPHEN 45 has proved its effectiveness in cooling towers for two years.

NEW PRODUCT solves problem in cooling water

The problem of bacterial and algal slime control in cooling water can be solved *economically* by a new Monsanto chemical—Santophen 45. It is particularly effective in cooling waters acidified to pH 5.5 to 6.5, a common practice today.

The effectiveness of Santophen 45 (sodium trichlorophenate, technical) has been proved in two years of practical use in cooling towers with capacities up to 600,000 gallons. Results in the towers confirm laboratory findings.

Santophen 45 can be used alone or as an extender for hard-to-get slime-control agents such as chlorine, sodium hypochlorite, sodium pentachlorophenate and others. Used in combination with other slime-control chemicals, enhanced action against a wider range of microorganisms is achieved.

Santophen 45 is economical. Its use avoids the expense of tearing down condensers to remove slime deposits.

Send for test sample and availability information on Santophen 45—the chemical that solves bacterial and algal slime problems. Contact the nearest Monsanto Sales Office, or MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

Santophen: Reg. U. S. Pat. Off.

DISTRICT SALES OFFICES: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto (Canada) Ltd., Montreal.

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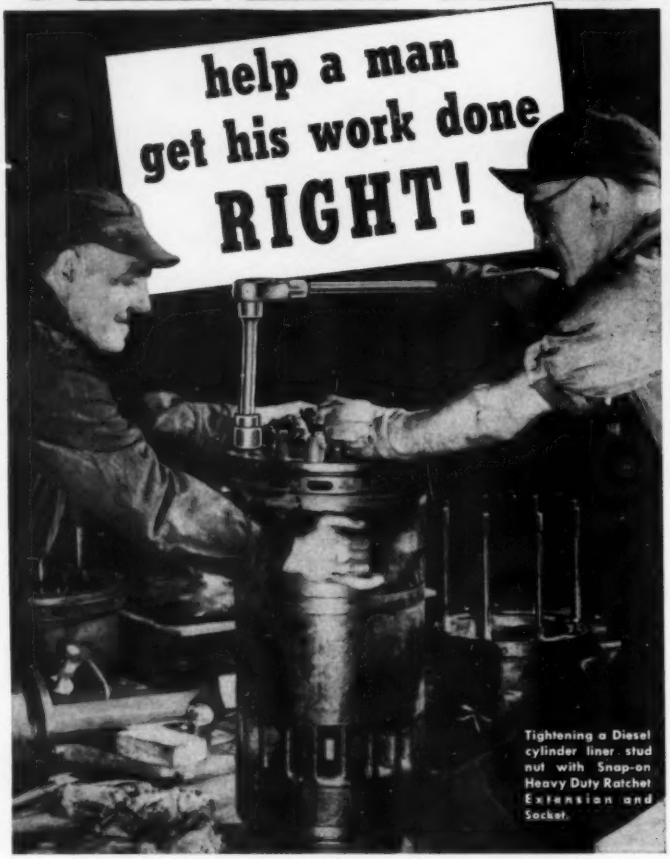

Tightening a Diesel cylinder liner stud nut with Snap-on Heavy Duty Ratchet Extension and Socket.

● On the high iron, the highways and the high seas, Diesel maintenance goes faster, surer, with Snap-on *Professional* Tools. *Stands to reason!* Snap-on Tools are engineered for the tool-crib, instead of the store counter. For men to *use*, and *use hard*. They're husky where it counts most, slim and trim to reach into tight spots. Their toughness comes from *core-to-surface* tempering. They'll serve longer, cut your tool costs, cut down-time! Close-at-hand service to industry everywhere through 41 direct factory branches. Write for Snap-on Industrial Catalog and 104-page General Catalog.

*Snap-on is the trademark of Snap-on Tools Corporation.

SNAP-ON TOOLS CORPORATION
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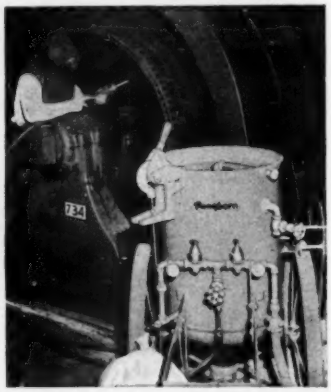


NO Drying Period Toxic Hazards

with New Pangborn AC-4 Blast Machine

NOW YOU CAN clean electric motors, generators and turbines *without solvents!* The new Pangborn AC-4 Blast Machine scours armatures, parts, frames, coils, etc. with soft (20-mesh) corncob grits.

Since no liquids are used there is no need for drying periods and toxic or explosive hazards are eliminated. Large equipment can be cleaned *in place* and no residue is left to create gum or to break down insulation.

Simple and Inexpensive

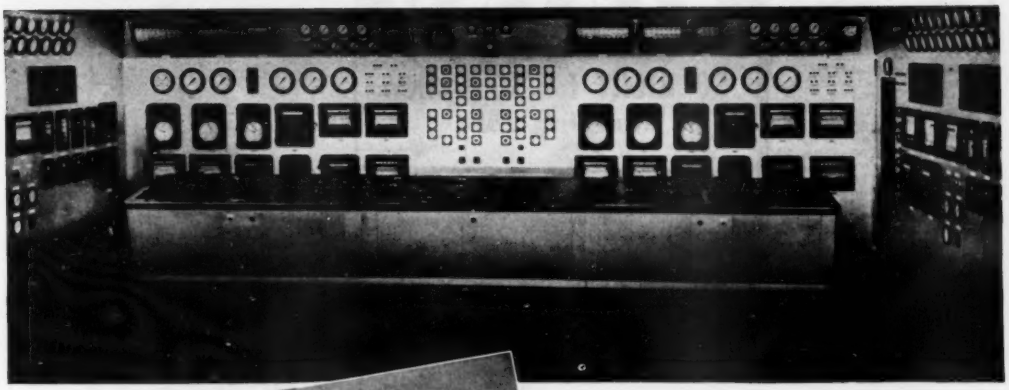
New Pangborn AC-4 Blast Machines operate from a standard 40-pound air supply. Material costs average 1/10 of other methods and complete cleaning is finished in half the time.

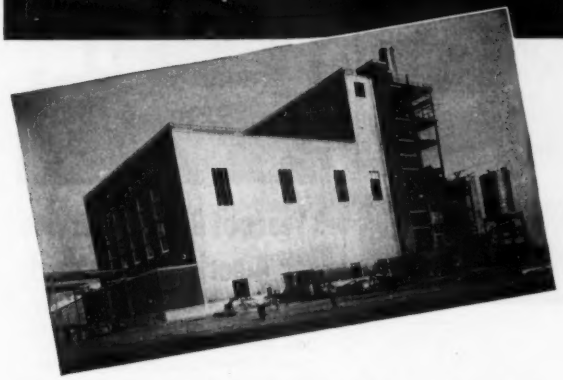
FOR DETAILS, write today outlining your operation. Address: PANGBORN CORPORATION, 90 Pangborn Blvd., Hagerstown, Maryland.

Look to Pangborn for the Latest Developments in Blast Cleaning and Dust Control Equipment

Pangborn
BLAST CLEANS CHEAPER with the right equipment for every job

DURAGAUGE *specified . . .*





. . . *another major installation of*

ASHCROFT DURAGAUGES

Shown above is the central control room of the new Edge Moor Power Station of the Delaware Power and Light Company now under construction by United Engineers & Constructors, Inc.

Recognized as "the standard of the industry," the Ashcroft Duragauge has an unmatched record of performance in the most severe installations to be found in the power field.

The Duragauge, as engineers will verify wherever it is installed, combines the most modern concepts of design and manufacture with experience that goes back over a century.

THE NYLON MOVEMENT is exclusive with the Duragauge. It provides unprecedented impact absorption, retention of form and shape under high temperatures, low friction, and corrosion resistance.

BOURDON TUBE MATERIALS for every service. These include phosphor bronze, beryllium copper, Monel, alloy steels, and stainless steels 316, 431, and 347.

CASE DESIGNS for any purpose in phenol condensate, "alumalife," iron, and brass. Stem, flush or wall mounting.

ROTARY MOVEMENT DESIGN enables recalibration in the field with maximum accuracy in minimum time.

See your local distributor for the gauge that means lowest maintenance costs—the Ashcroft Duragauge. He invites your inquiries.

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Asphalt	Lye
Alcohol	Lubricating Oils
Brines	Milk
Benzine	Molasses
Bleaches	Naphtha
Blood	Mineral Oils
Cream	Olive Oil
Chocolate	Paints
Caustics	Paint Oils
Chemicals	Petroleum
Coal Tar	Pitch
Creosote	Plastics
Dishwater	Printing Inks
Drugs	Road Oils
Dyes	Soap Liquors
Ether	Starch
Fuel Oils	Sizing Liquids
Food Products	Soy Bean Oil
Gasoline	Syrups
Glycerin	Tar
Glue	Tomato Juice
Glucose	Turpentine
Grape Juice	Varnish
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Juices	Viscose
Kerosene	Water
Lacquer	Wine
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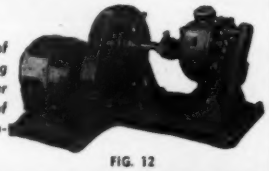

FIG. 12

See Our Catalog In SWEETS

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Cedar Falls, Iowa

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NO. 401 is designed to give you everything you want in a sensitive diaphragm motor valve and pressure controller for pressure reducing service on steam, air, or gas. The controller may be mounted on the valve or installed remotely on an instrument panel. The valve is a spring loaded, balanced disc type of rugged construction suitable for indoor or outdoor installation. Offered in a complete range of sizes from ½" to 10" for initial pressures to 600 p.s.i. and any reduced pressure from 500 down to 1 p.s.i. When making inquiry, state service unit is to perform, size of valve required, and pressure and temperature specifications. The Davis line of pressure regulators is complete; there is a type and size for every purpose. Ask for Bulletin 100A.

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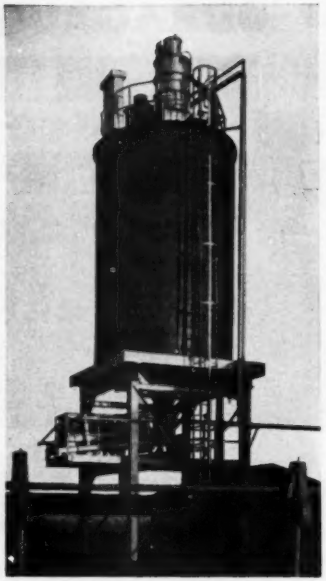
ASK FOR NEW CATALOG A-50

AUTOMATIC PRESSURE, FLOW, AND LIQUID LEVEL CONTROLS SINCE 1875



3 Years of Rugged Service for American Cyanamid

The National Ash Conveyor system shown was installed 3 years ago at The American Cyanamid Company plant in Newcastle, Pa. Its performance during this time is ample proof of the sound engineering and wear-resistant materials that go into our equipment. We now are installing a second unit at the Bridgeville plant of the same company.

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National does not consider a completed installation its final responsibility . . . expert servicing for National Systems is always available. A free yearly check-up and quick delivery of replacement parts, from fully adequate stocks, is part of our service. A 25-year record for promptness and dependability has made strong friends of our many clients.

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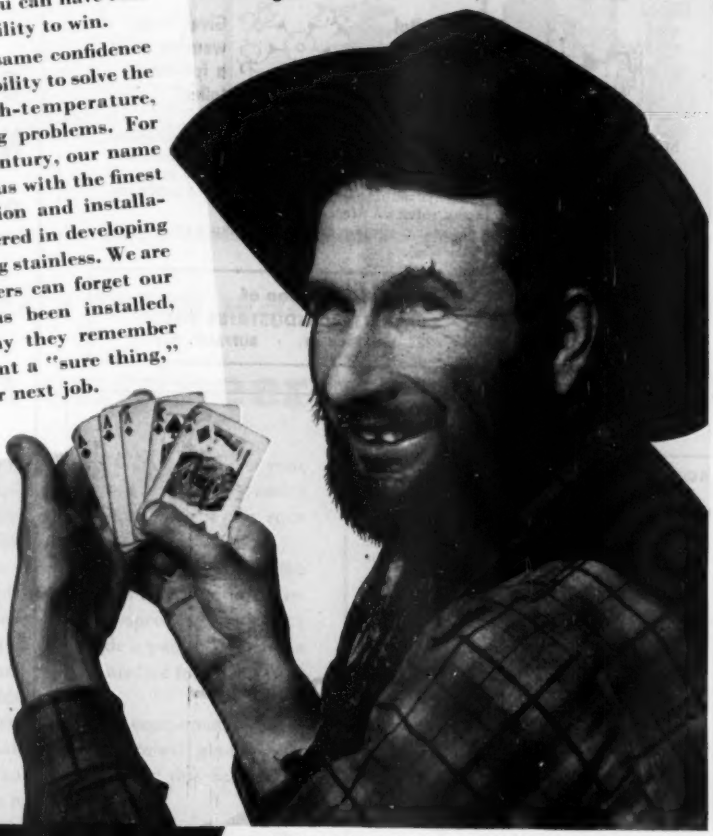
50 CHURCH ST., NEW YORK 7, N.Y.
Manufacturers of The National ChipVeyor System for Metal Turnings - Furnace Doors - Feeders - Ash Gates and Related Equipment

It's a good bet

When you draw a hand like this in a poker game, you don't need to be afraid to bet. Your knowledge of the odds tells you that you can have real confidence in your ability to win.

You can have the same confidence in our time-proved ability to solve the most exacting high-temperature, high-pressure piping problems. For more than half a century, our name has been synonymous with the finest in pipe prefabrication and installation, and we pioneered in developing methods for welding stainless. We are proud that engineers can forget our piping once it has been installed, because that's why they remember us. . . . If you want a "sure thing," let us handle your next job.



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Gives each wearing point a full-time 'oiler'

Manufacturers using Manzel Lubricators report that they save their initial cost many times over in reduced labor cost, lower oil consumption, and fewer breakdowns. "Manzels" are standard equipment on many makes of engines, pumps, compressors, hydraulic presses, conveyors, and other machinery. Or . . . you can install them on present equipment.

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WHAT'S THE BEST WAY TO STRIP PAINT FROM METAL PARTS TOO LARGE TO BE SOAKED IN TANKS?
See Page 3

Oakite's New FREE Booklet on Paint Stripping

answers many questions that will lead you to better stripping procedures. You'll want to read more about:

What's the best way to strip large areas of structural metal where a steam supply is available? *See page 5.*

What is the best method when steam is not available? *See page 7.*

What is the cheapest way to strip metal parts in large volume? *See page 9.*

What are the best ways to prepare stripped surfaces for repainting? *See page 11.*

What strippers are best for removing oil-base paints? . . . Synthetic enamels, alkali-resistant plastics or resin-based paints? . . . Japans, wrinkle finishes, nitrocellulose lacquers, alkyds, phenolics and ureas? *See page 12.*

FREE For a copy of "How to STRIP PAINT" write to Oakite Products, Inc., 23A Thames St., New York 6, N. Y.

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WHAT EQUIPMENT DO YOU NEED FOR YOUR BOILER WATER TREATMENT?

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- ☐ Zeolite Softeners
- ☐ Exchanger Minerals
- ☐ Filters
- ☐ Supporting Beds
- ☐ Test Equipment
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- ☐ Chemical Pumps, Mechanical
- ☐ Chemical Pumps, Acid
- ☐ Timers
- ☐ Motor Starters
- ☐ Continuous Blowdown Systems
- ☐ Cooling Water Samplers

TANKS
☐ Hand or ☐ Mechanical AGITATION (circle capacity desired) 53, 110, 180, 330, 580 or 1,350 gallon capacity.

FEEDING SYSTEMS
- ☐ By-Pass Feeders
- ☐ Automatic Intermittent
- ☐ Cycle Controlled

VALVES
- ☐ Flo-Control
- ☐ Acid-Resistant Check Valves
- ☐ Acid Regulating and Shut-Off

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Dearborn Chemical Company, Dept. PO, 310 South Michigan Ave., Chicago 4, Illinois

Gentlemen:
Please send information on the equipment checked in the above list.

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Company.....

Position.....

Address.....

City.....*State*.....

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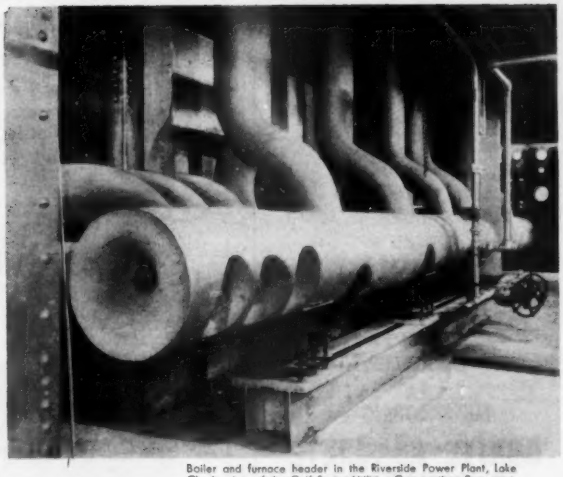
In every temperature range—

KEASBEY & MATTISON INSULATIONS DELIVER MORE HEAT AT LESS COST!



Boiler and furnace header in the Riverside Power Plant, Lake Charles, La., of the Gulf States Utilities Corporation, Beaumont, Texas. **Insulation Contractor:** Armstrong Cork Company.

Whatever your heat insulation problem, you'll find a Keasbey & Mattison covering that will solve it better. Consider the two K&M Insulations used in the above installation, for instance:

"FEATHERWEIGHT®" 85% MAGNESIA

Keasbey&Mattison"Featherweight"85%Magnesia withstands temperatures up to 600° F. without loss of insulating value. It is structurally strong, yet exceptionally light in weight. Alternate heating and cooling, wetting and drying does not effect its insulating properties. Its thermal efficiency remains unaffected after years of service.

HY-TEMP COMBINATION

This efficient and practical insulation combines the high heat-resistant properties of Keasbey & Mattison Hy-Temp with the superior insulating qualities of "Featherweight" 85% Magnesia. This makes Hy-Temp Combination Insulation suitable for exacting temperature control up to 1900° F.

Your Keasbey & Mattison Distributor — who is an experienced applicator — will be glad to give you complete information on these or any K&M Insulations. Or, write us direct.

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Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
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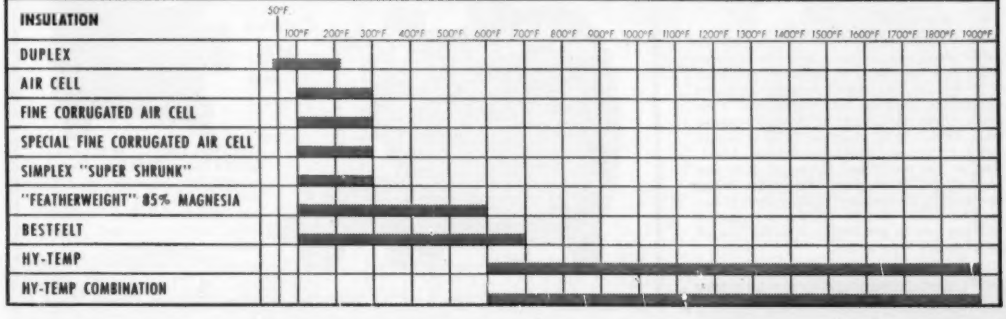
THERE'S A KEASBEY & MATTISON INSULATION FOR EVERY NEED



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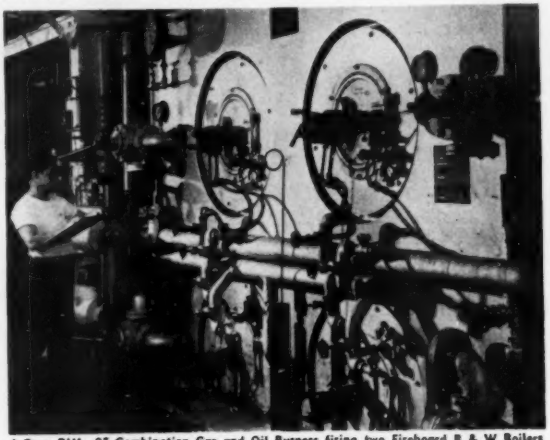
Combination Gas and New Wide Range Low Steam Consumption "MW" Oil Atomizer



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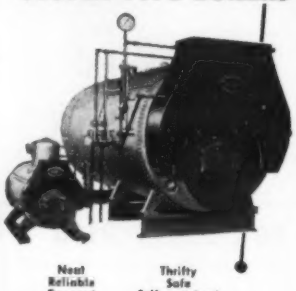
LEFFEL

SCOTCH TYPE BOILERS



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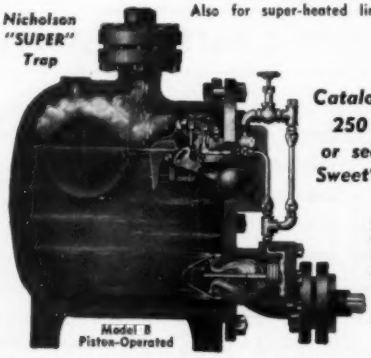
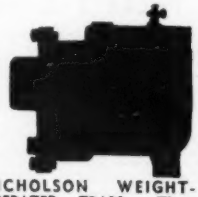


Model B Piston-Operated

Catalog 250 or see Sweet's



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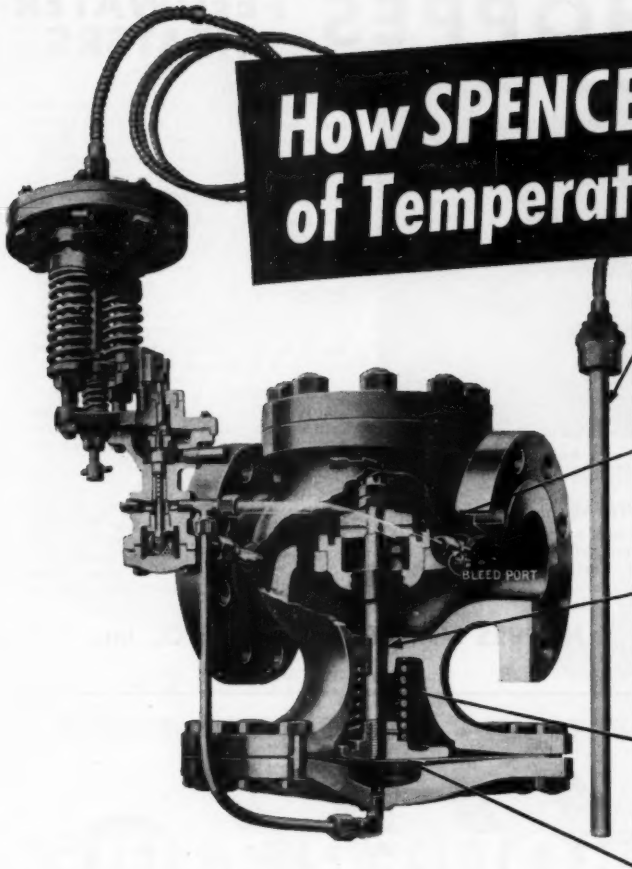
How SPENCE Cuts Costs of Temperature Control



NEW THERMOSTAT ELEMENT—Improved to practically eliminate loss of filling. Rugged construction; cannot be injured by overheating.

SECO METAL—Seats and discs are made of SECO Metal—guaranteed not to wire-draw.

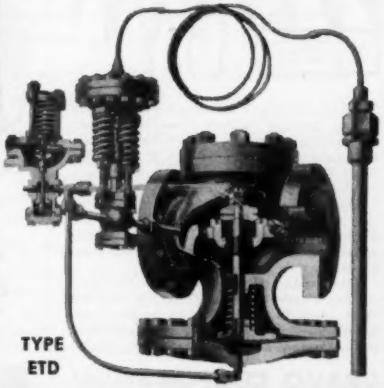
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

PROTECTED SPRINGS — Springs in the Spence Regulator are out of the path of the steam or other fluid flowing through the valve.

LARGE BALANCED DIAPHRAGM— Spence metal diaphragms, under usual conditions, never require replacement.

Accurate Control for Both Storage and Instantaneous Heaters

Spence Temperature Regulators reduce the steam pressure and also accurately modulate the flow as required to control the temperature. No separate reducing valve is necessary • The Spence ET150 Regulator is recommended for heater pressures up to 50 psi. For higher pressures the Type ETD is available • For complete details on the entire Spence line of automatic regulating valves, strainers and desuperheaters, write for Bulletin 1200.

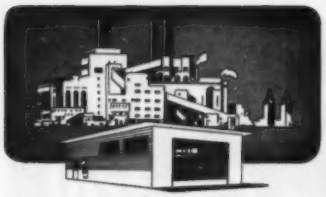


TYPE ETD

SE 111

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK



Industrial Sound Control

QUIETS POWER PLANTS

ENDS ANNOYANCE
COMPLAINTS
LOW EMPLOYEE MORALE
THREATS OF LEGAL ACTION
Due to Disturbing NOISE

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INDUSTRIAL SOUND CONTROL

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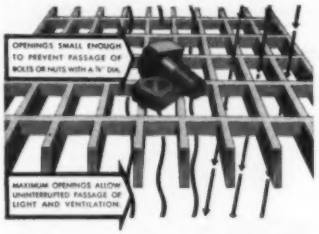

OPENINGS SMALL ENOUGH TO PREVENT PASSAGE OF BOLTS OR NUTS WITH A ½" DIA.
MAXIMUM OPENINGS ALLOW UNINTERRUPTED PASSAGE OF LIGHT AND VENTILATION

Tri-Lok strength is obtained by truss action through twisted cross-bar, curved in opposite directions at each bearing-bar. Standard openings in Tri-Lok Rectangular Steel Flooring are 1" x 3⅞"—other sizes can be supplied as required.

Diagonal, or Super-Safety U-type Flooring, and stair treads of all types, are available. Bulletin KF 1140 describes the construction features of Tri-Lok Open Steel Flooring.

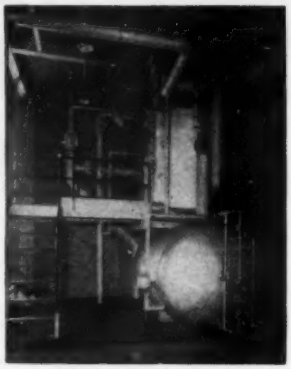
The Tri-Lok Company is also equipped to furnish *riveted* and Tri-Forge *welded* open steel flooring. Tri-Lok grating can be furnished in a variety of metals, including aluminum alloy, stainless steel, etc.

DRAVO CORPORATION

National Distributor for the
Tri-Lok Company
Dravo Bldg., Pittsburgh 22, Pa.
Sales Representatives
in Principal Cities

DRAVO

HOPPES FEEDWATER HEATERS



Deaerating feedwater heater serves as condensation return pump for trapped and pumped returns from heating system

ENGINEERING SERVICE:

Hoppes engineers work with you to assure that your individual and specific requirements are provided for in full. Let's talk it over—get the economy angle.

DEAERATING:

For medium and high pressure Central Stations; modern Industrial and Process Plants; Steam Heating Plants and all Modern Power Plants which have boilers operating at medium and high pressures.

NON-DEAERATING:

For Laundries; small Industrial Plants; Institutions and all smaller Power Plants where boilers are operated at lower pressures and where economy of investment is desired.

PLATE TYPE:

Deaerating heaters of plate type are designed for capacities up to 85,000 pounds per hour. Non-deaerating heaters include capacities up to 120,000 pounds per hour.

CAST IRON:

(Integral Unit) Designed to meet space limitations, their outlet capacities range from 3,000 pounds per hour to 15,000 pounds per hour.

STEEL TYPES:

These heaters are more diversified and are obtainable as follows—Vertical or Horizontal heaters with integral storage; vertical heaters mounted on vertical storage tanks; vertical heaters mounted on horizontal storage tanks and horizontal heaters mounted on horizontal storage tanks.

HOPPES MANUFACTURING CO., Inc.

Established in 1881
SPRINGFIELD, OHIO

BOILER TUBE CO. OF AMERICA

Tube Stocks and Bending

BOILER TUBE CO. OF AMERICA
McKEES ROCKS, PA.
(Pittsburgh District)

PITTSBURGH
CHICAGO

FRED S. RENAULD & CO.,
LOS ANGELES

Call in this Remarkable Instrument

TO INCREASE
POWER OUTPUT AT NO INCREASE IN COST

THE Cities Service Industrial Heat Prover is a flue gas analyzer which quickly, accurately and completely determines the heat generating efficiency of equipment using any type of fuel. With this information necessary adjustments to increase efficiency can be made.

A complete new line of petroleum products for the power field including:

- **D-C Diesel Engine Oils**
- **Pacemaker, Turbine and Compressor Oils**
- **Optimus Cylinder Oils**
- **Sentry Plant Machinery Oils**

The Heat Prover gives you the answers to these questions important to efficient production:

1. **How much energy is wasted in uselessly heating excess air?**
2. **How much excess oxygen is present in furnace gases?**
3. **What percentage of fuel is converted into useful heat?**

For a complete description of Cities Service Industrial Heat Prover Service, mail the coupon below for your copy of "Combustion Control for Industry."

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

CITIES SERVICE OIL CO.
Sixty Wall Tower, Room 978
New York 5, N. Y.
Please send me without obligation your new booklet entitled "Combustion Control for Industry."

*Name*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

MERCOID CONTROLS

Designed to automatically regulate electrically operated equipment in accordance with changes in temperature, pressure, vacuum, fluid level or mechanical movement. Equipped exclusively with corrosion-proof mercury switches.

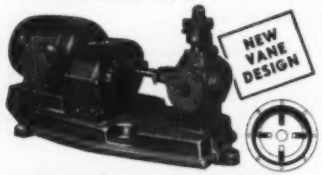
They Have What Experienced Engineers Want—
POSITIVE SAFETY • YEARS OF DEPENDABLE PERFORMANCE
EASE OF INSTALLATION • CONVENIENT ADJUSTMENTS

Catalog sent upon request

THE MERCOID CORPORATION
4201 BELMONT AVENUE • CHICAGO, ILLINOIS

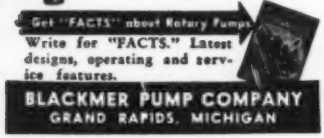
MODERNIZE WITH *Liquid Material Handling* EQUIPMENT

Handling costs are controllable . . . downward . . . with Blackmer Pumps and piping wherever liquid materials are used in processing or compounding. Power pumps from 5 to 1500 g.p.m. are sized for any requirement.



HAND PUMPS FOR DISPENSING

Blackmer Hand Pumps promote safety, good housekeeping and economy.



Write for "FACTS." Latest designs, operating and service features.

BLACKMER PUMP COMPANY
GRAND RAPIDS, MICHIGAN

Stickle System cuts canner's fuel costs and cooking time 50%

An Ohio canning and processing plant, handling 100 tons of tomatoes per day, installed the Stickle Differential Drainage and Boiler Return System shown below. RESULTS: Coal consumption cut from 10 to 5 tons a day; firemen reduced from 4 to 2; condensate returned to boilers at 325°; at 100 lbs. boiler pressure, cooking time for tomato puree reduced from 35 minutes to 16 minutes for 1.05 specific gravity. Stickle System *paid for itself the very first season installed!*

Let us show you how this Stickle System will save you money. Minimum fuel saving for your operations is *guaranteed* before installation. And performance precedes payment—you must be satisfied! Send for *free* details below.*

STICKLE STEAM SPECIALTIES COMPANY
2265 Valley Ave., Indianapolis, Ind.

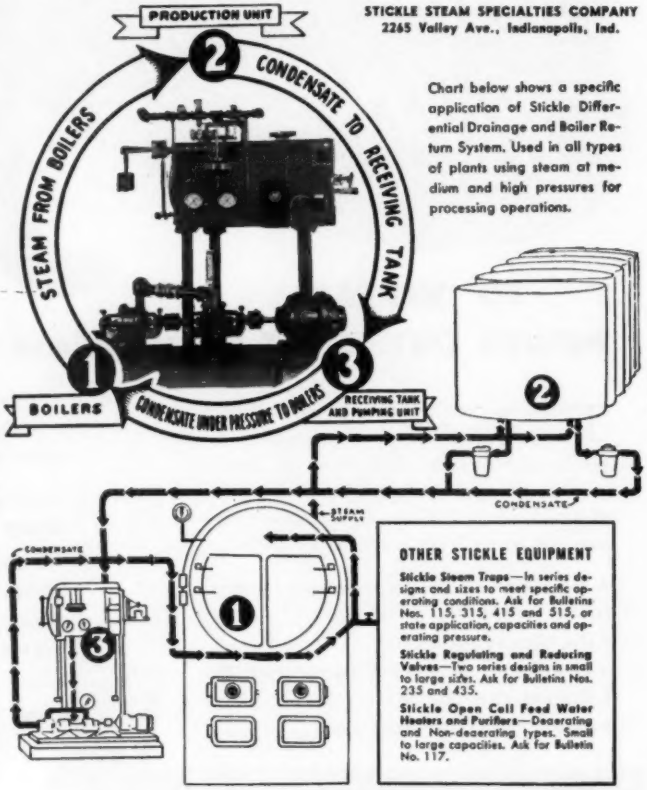


Chart below shows a specific application of Stickle Differential Drainage and Boiler Return System. Used in all types of plants using steam at medium and high pressures for processing operations.

OTHER STICKLE EQUIPMENT

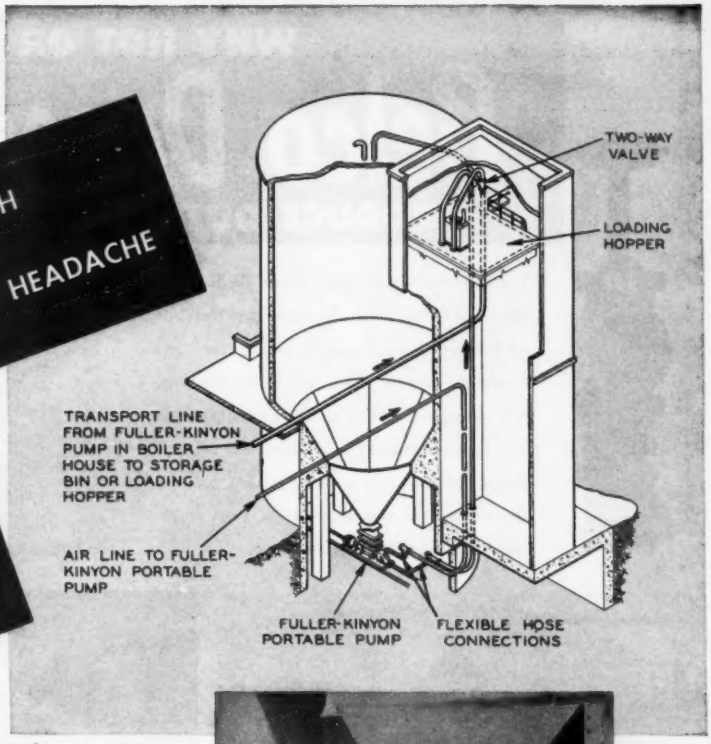
Stickle Steam Traps—In series designs and sizes to meet specific operating conditions. Ask for Bulletins Nos. 115, 315, 415 and 515, or state application, capacities and operating pressure.

Stickle Regulating and Reducing Valves—Two series designs in small to large sizes. Ask for Bulletins Nos. 235 and 435.

Stickle Open Coil Feed Water Heaters and Purifiers—Deaerating and Non-deaerating types. Small to large capacities. Ask for Bulletin No. 117.

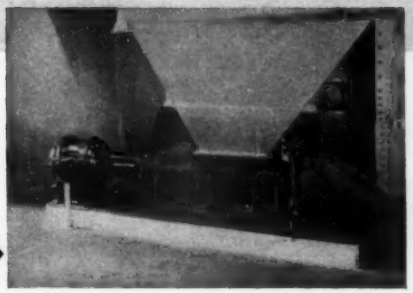
***FREE!** A copy of above canner's letter, plus generously diagrammed Bulletin 250 and simple estimate data sheet for System installation. Write address above—*today!*

FLY ASH WAS A HEADACHE


TWO-WAY VALVE
LOADING HOPPER
TRANSPORT LINE FROM FULLER-KINYON PUMP IN BOILER HOUSE TO STORAGE BIN OR LOADING HOPPER
AIR LINE TO FULLER-KINYON PORTABLE PUMP
FULLER-KINYON PORTABLE PUMP
FLEXIBLE HOSE CONNECTIONS

Fly-ash storage and handling facilities. Fuller-Kinyon Portable Pump for conveying from present storage bin, or future bins, to loading hopper for bulk-car loading.

Fuller-Kinyon Stationary Pump installed in boiler house.



Fly ash, once a nuisance to generating stations, is becoming a source of profit today. Now, concrete products manufacturers are using large quantities of it—and demanding even more.

Handling this once-valueless waste was a tough, dirty, expensive job—until Fuller-Kinyon pumps took over the task of conveying it. From collector hoppers to storage bins or to bulk-car loading hoppers—Fuller-Kinyon pumps convey fly ash and send it anywhere, cleanly, efficiently, around corners, in any direction.

If your plant produces fly ash, in quantity, call in a Fuller Engineer. He'll discuss recovery and disposal—recommend whatever equipment may be needed. There is no obligation.

FULLER COMPANY, Catasauqua, Pennsylvania • Chicago 3—120 So. LaSalle St. • San Francisco 4—420 Chancery Bldg.

fuller

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS • COMPRESSORS AND VACUUM PUMPS • FEEDERS AND ASSOCIATED EQUIPMENT

P-126

7257

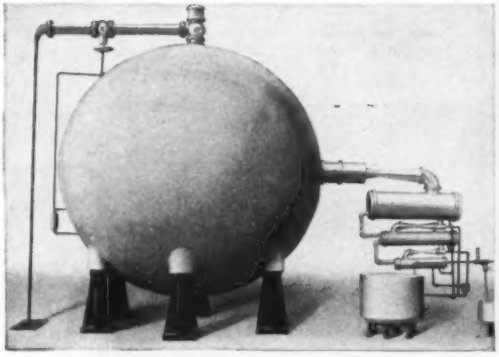
WHY HOT OR COLD TYPE Belco Deaerators PRODUCE OUTSTANDING RESULTS!

The Belco Atomizing Valve is used in the initial step of all Belco Heaters, Deaerators and Hot Process Softeners to insure superior results. The Valve divides the incoming water into such finely atomized droplets that heating is practically instantaneous when sprayed into an atmosphere of steam. Because of the rapid primary heating, the subsequent steps of separation of the gases and/or chemical action are greatly facilitated.

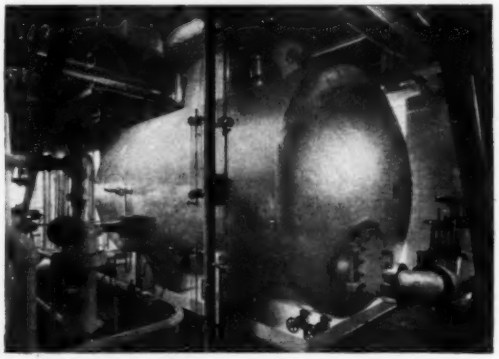
The Belco Atomizing Valve Provides:

1. The Finest Spray
2. Instantaneous Heating
3. It's own Level Control
4. A Balanced Type Valve
5. Non Clogging—Self Cleaning ports
6. Visual Position Indicator
7. External Adjustments
8. Uniform Spraying over entire flow range
9. Capacities of 1 to 2,000 gpm

In the second-step scrubber section large volumes of steam contact the preheated water and insures complete ebullition and complete removal of all corrosive gases. The oxygen content of the effluent from a Belco Deaerator is less than 0.005 ml. per liter. More information in illustrated Bulletin 103.



BELCO SPHERICAL VACUUM DEAERATOR
Capacity—1,000,000 lbs. per hour
Operating pressure—0.2 ins. hg absolute
Located at large Midwest Chemical Plant



BELCO HIGH PRESSURE STEAM DEAERATOR
Capacity 300,000 lbs. per hour
Operating pressure—30 psig.
Located at large Canadian Oil Refinery

BELCO COMPETENT ENGINEERING—The many years of experience behind Belco's well informed staff of engineers, both in the field and on the drawing board, covering the types of equipment listed below, is available to you at all times. Call on these engineers for authoritative assistance and close cooperation.

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.

BOGUE ELECTRIC MANUFACTURING COMPANY

PATERSON 3, NEW JERSEY

BELCO PRODUCTS

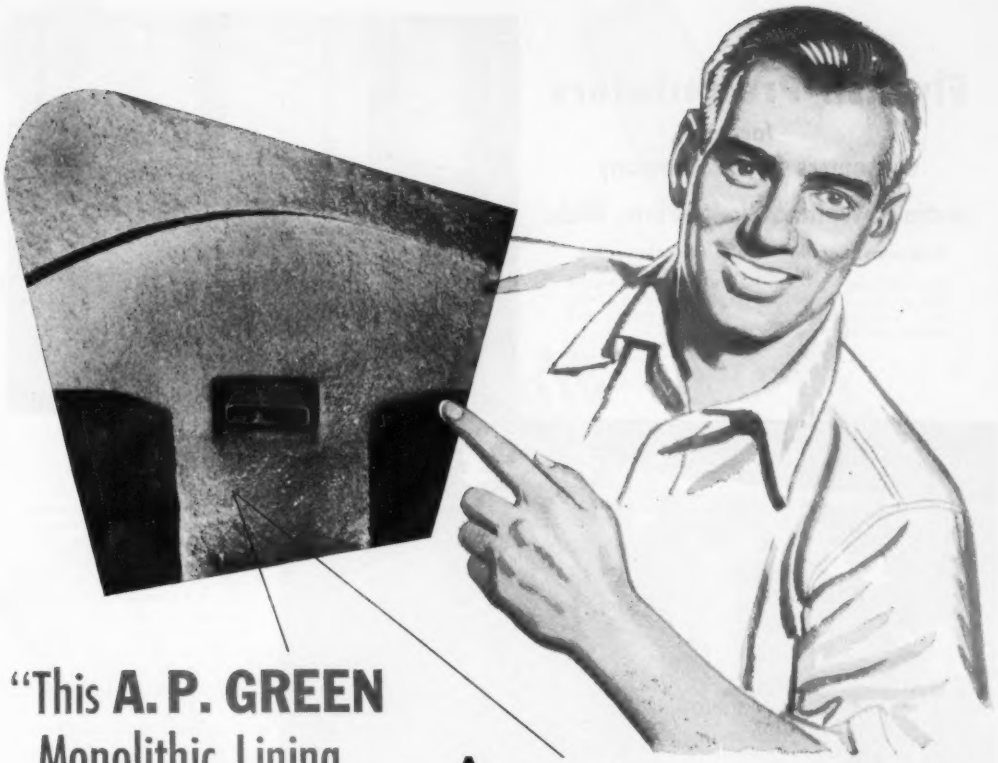
SWIMMING POOL PURIFICATION EQUIPMENT: Automatic and Manual • **WATER SOFTENERS:** Hot Lime Soda, Belcolite, Gravity and Pressure Types, Automatic and Manual • **FILTRATION EQUIPMENT:** Gravity and Pressure Filters, Automatic and Manual Filters, Siliceous and Non-Siliceous Filters, Iron, Oil, Taste, Odor and Color Removal Filters • **DIATOMACEOUS EARTH FILTERS** • **COAGULATION EQUIPMENT:** Slow and Rapid Mix Agitators (Adjustable variable speed), Setting Tanks, Sludge Removers • **SPECIAL EQUIPMENT:** De-ionized (Equivalent to Distilled) Water Equipment, Silica Removal Equipment, Boiler Feed Water Heaters, Deaerators, Degasifiers, Chemical Dry Feeders, Chemical Pressure Feeders, Oil Separators (Refining process type) • **AUTOMATIC PROCESS CONTROL**

BOGUE PRODUCTS

MAGNETIC AMPLIFIERS: Magnetic Type Voltage Regulation, Magnetic Type Speed Regulation, Servo Systems • **PETROLEUM EQUIPMENT:** Tank Gauging Equipment (Automatic for open or closed tanks) • **MARINE EQUIPMENT:** Surface Search Radar, Automatic Steering Equipment, High Capacity Bilge Pumps • **ELECTRONIC COMMUNICATION EQUIPMENT** • **AIRCRAFT EQUIPMENT:** Automatic Aircraft Circuit Testers • **ELECTRICAL EQUIPMENT:** 400 Cycle Generators, Magnetic variable speed motor drives— (no vacuum tubes required), AC Motors—DC Motors, Synchronous Motors, Alternators, Investors, Generating Sets, Plating Equipment, Motor Generators.

Belco

PROCESSES FOR REMOVAL OF WATER IMPURITIES



"This A. P. GREEN Monolithic Lining has given 7 times the service of Firebrick"

A leading publishing company in St. Louis, using H. R. T. Boilers with underfeed stokers, formerly had to replace their firebrick linings every 12 months. After installing A. P. Green Monolithic linings they obtained 7 years' service *without repairs of any kind* in the furnace section of the boilers. Quality construction pays for itself in longer service life.

A. P. Green monolithic plastic linings eliminate air infiltration, are resistant to spalling and lose less heat through walls. They are adaptable to any thickness or contour and are easily repaired. A. P. Green floating anchors compensate for the differential in expansion between the refractory wall and the outer wall, thus eliminating the cause of many failures when firebrick construction is used.

There is an A. P. Green refractory product applicable to each type of service requirement in all types of industry:

SUPER PLASTIC, to meet certain extreme conditions
PLASTIC QUIK-PAK, a high heat duty refractory
KAST-SET, a high quality refractory castable
KAST-O-LITE, lightweight castable refractory with insulating properties.

For any refractory need, call your local A. P. Green Distributor; he's listed in the yellow pages of your telephone directory . . . or write direct.

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REFRACTORY PRODUCTS

A. P. GREEN FIRE BRICK CO.
Mexico, Missouri

Please send me a copy of your booklet on Plastic and Castable Furnace Linings.

NAME

FIRM NAME

ADDRESS

CITY ZONE STATE

Fly Ash Precipitators

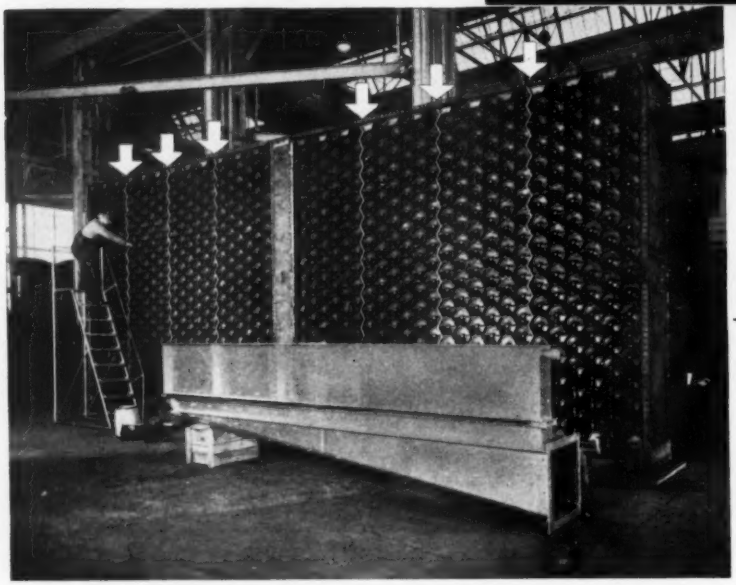
for

Consumers Power Company

Justin R. Whiting Plant at Erie, Mich.

Engineers: Commonwealth Associates, Inc.

Ever-increasing demand for electric power has prompted still another of America's great public utilities, Michigan's Consumers Power Company, to expand and enlarge its facilities and services.



1. Here are sections of a Type ST Fly Ash Precipitator, ordered by Consumers Power Company, being loaded into a railroad car. Because the units are furnished partially assembled, they are easier to handle and field erection is simplified. This precipitator will be used on a 690,000# steam/hr. pulverized fuel fired boiler for a flue gas volume of 350,000 cfm. A duplicate of this precipitator for a second boiler is in production now.

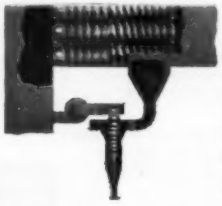
2. Assembled unit receives final inspection prior to shipment. There are 816 tube elements forming 2 banks and arrows indicate lines of mating sections which are match-marked to simplify assembly. Other American Blower equipment on this order for Consumers Power includes: 2 Forced Draft Fans and 2 Induced Draft Fans each equipped with Type PE Gyrol Fluid Drives together with 4 Gyrol Fluid Drives for Boiler Feed Pumps.

The simple principle of operation of the type ST Fly Ash Precipitator combines refinement, proportions and methods of construction which result in a more efficient, compact and economical unit.

If you have a fly ash problem and would like further information on American Blower Fly Ash Precipitators, write to our nearest Branch Office and literature will be sent to you without obligation.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation



Principle of Operation

Fly ash laden gases entering main tube are forced to outside by spinner element. This action sets up centrifugal force which concentrates fly ash near tube wall. Cleaned gases in center of tube pass on through outlet tube.

YOUR BEST BUY AMERICAN BLOWER POWER PLANT EQUIPMENT

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

1 **90° RIGHT OR LEFT SIDE ANGLE FOR SIDE INSTALLATIONS.** Can be tipped forward or backward for eye level reading.

2 **STRAIGHT INDUSTRIAL THERMOMETER** for inserting on horizontal pipe lines.

From any angle

Easy-Reading Taylor Industrial Thermometers invite frequent readings for better protection of your equipment.

1 **Exclusive,** three-times-easier-to-read Binoc* tube actually invites *frequent* reading.

2 **Extra-bold** black numerals stand out sharply on white background.

3 **Fast, accurate** indications of all temperatures within minus 40° to plus 950°F., or equivalent Centigrade.

4 **Built** to give you many years of rugged, dependable service.

5 **Available** with a wide variety of stems and connections. Write for CATALOG E today!

Taylor Instrument Companies,
Rochester, N.Y., and Toronto, Canada.

*Registered Trade-Mark

3 **135° OBLIQUE RIGHT OR LEFT SIDE ANGLE** for difficult locations.

4 **90° ANGLE INDUSTRIAL THERMOMETER** for vertical pipe lines.

Taylor Instruments MEAN **ACCURACY FIRST** IN HOME AND INDUSTRY

Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.

WHY SO MANY LURES?

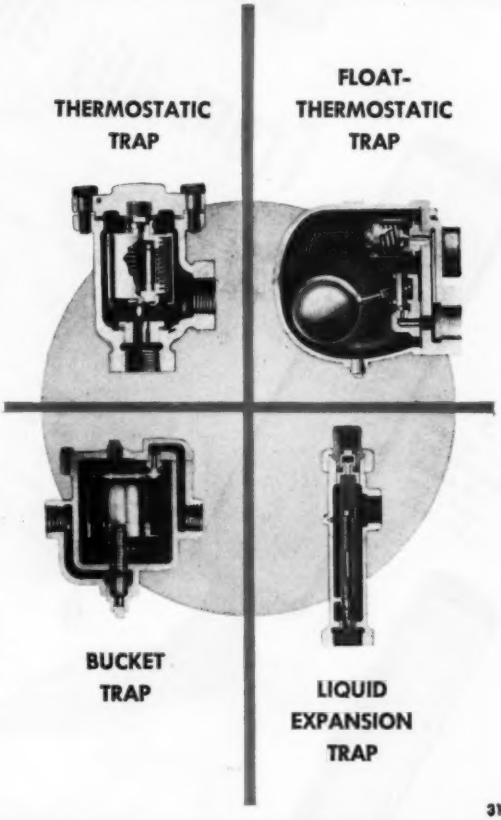
A practical idea for users of STEAM TRAPS

Many readers of this publication can remember when there was only one kind of steam trap and when one trap to a room or a building was enough. As long as the trap "tilted," everybody was happy.

The science of steam trapping has come a long way since then but we still have with us the engineer who tries to "standardize" on one type of trap for the whole plant and the steam man who doesn't realize that the cost of Sarco traps is so reasonable today that it pays to put one on each coil.

One thing is certain. You will need several types of steam traps to lure the utmost out of your fuel and your production equipment. Sarco makes five distinct types of steam traps and is in a position to recommend the right type for each job.

And you can't tell by the cost. An inexpensive type of trap may be the best and the most expensive trap the worst type you could use on any particular job. You can get the right trap the first time for each job by asking the Sarco Specialist near you or writing for our Selection Chart No. 1600.



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SARCO
SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

Zallea Expansion Joint News

PUBLISHED BY ZALLEA BROTHERS—WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

Expansion Joint of the Month

HINGED TYPE JOINTS

Zallea Stainless Steel Hinged or Rotation Type Expansion Joints have successfully served industry and government for over a decade. Normally designed to absorb expansion in one plane by rotation, we now offer hinged expansion joints of the universal type for rotation in all planes and a combination of rotation and axial movement in a single unit. Designed for piping systems which, because of their size and location, cannot be supported or anchored in the conventional manner, a minimum of 2 hinged joints is required for a single installation. Self-supporting at all times, each expansion joint bends angularly giving the same effect as a hinge at each elbow. This action reduces bending stresses in the piping and eliminates cumbersome anchors and supports. Being a special purpose product, they must be specifically designed for each individual application. Your inquiry should include a drawing of the piping installation, stating maximum pressures and temperatures and any special conditions that may exist. Without this information, proper design and installation cannot be achieved.

The supply is going fast...send TODAY for your copy of Catalog 47, a text book and valuable reference source on all Zallea Expansion Joints.

ZALLEA BROTHERS, 814 Locust Street, Wilmington 99, Delaware

GULF OIL USES ZALLEA

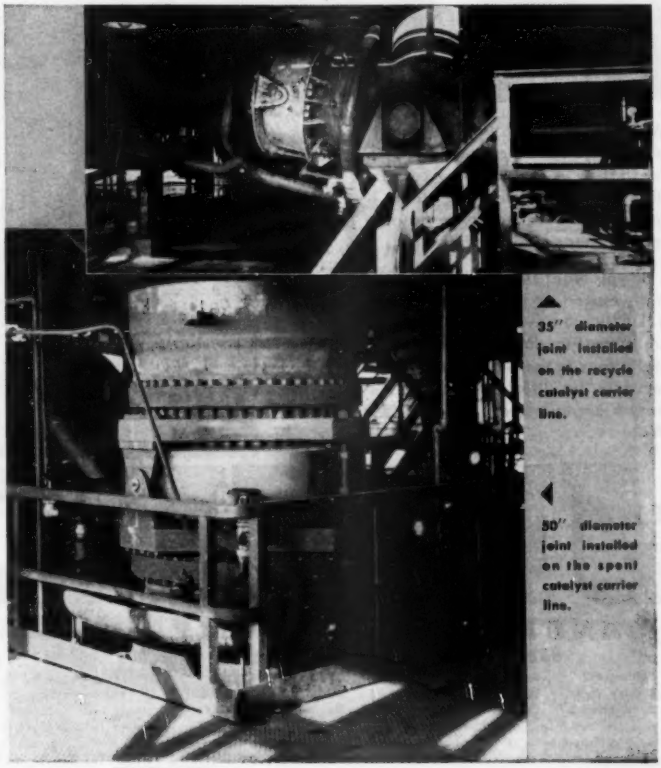
TWO HINGED JOINTS USED ON "CAT" CRACKER

Pictured here are two Zallea Stainless Steel Hinged Expansion Joints, installed on a "cat" cracker at Gulf Oil's Philadelphia refinery. The 35" diameter joint is used on the recycle catalyst carrier line and the 50" diameter joint is installed on the spent catalyst carrier line. Installation of these Zallea Hinged Expansion Joints was made without difficulty during a routine shut-down early in 1950. Since that time operation has been reported to have been maintenance-free.

Built For Long Service

In similar jobs in other refineries . . . whenever there is a need for simplified piping . . . Zallea Stainless Steel Hinged Joints are used . . . often as replacements for competitive expansion joints in existing lines. Each Zallea Stainless Steel Hinged Expansion Joint is designed for a specific job—designed after a thorough study of the piping problems involved. On special order, they are available in sizes up to 30 feet in diameter, as well as for temperatures up to 1600° F.

When the job calls for expansion joints of any type and size—insist on Zallea—you'll find it pays!



▲ 35" diameter joint installed on the recycle catalyst carrier line.

◀ 50" diameter joint installed on the spent catalyst carrier line.

(Advertisement)

COAL ON THE MOVE

Jeffrey Belt Conveyors are used for long hauls—both horizontally and on the incline. Jeffrey Steel Apron Conveyors (left) for large capacities and short hauls. Both available in widths to suit requirements.

When most people think of coal they think of Jeffrey. That's a good habit to get into for Jeffrey moves a lot of coal in a year's time by some method or other. Two ways are shown here . . . two ways of moving large tonnages day after day.

If you want to speed coal (or other loose bulk material) on its way—tell us about it. Likely we have worked out the best possible way to do it, using hundreds of installations in the past. Your handling problem may be different. Give us a chance at it. Our engineers will be glad to help you. Write today.

THE JEFFREY MANUFACTURING COMPANY

Established 1877

932 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

JM

Baltimore 2	Boston 16	Cincinnati 2	Detroit 13	Jacksonville 2	Philadelphia 3	Salt Lake City 1
Beckley, W. Va.	Buffalo 2	Cleveland 15	Harlan, Ky.	Milwaukee 2	Pittsburgh 22	Scranton 3
Birmingham 3	Chicago 1	Denver 2	Houston 2	New York 7	St. Louis 1	

Jeffrey Mfg. Co. Ltd., Montreal, Canada
Jeffrey-Galion (Pty.) Ltd., Johannesburg, S.A.
The Ohio Malleable Iron Co., Columbus, Ohio
British Jeffrey-Diamond Ltd., Wakefield, England
The Galion Iron Works & Mfg. Co., Galion, Ohio
The Kilbourne & Jacobs Mfg. Co., Columbus, Ohio

Repeat Orders for Pacific BOILER FEED PUMPS

Reflect Customer Confidence In Product and Service Rendered

1	Original Purchase	1 unit—486,000 lbs. per hour—1600 psi discharge pressure.
	FIRST REPEAT	5 units each—800,000 lbs. per hour—2430 psi discharge pressure.
	SECOND REPEAT	6 units each—650,000 lbs. per hour—2430 psi discharge pressure.
2	Original Purchase	3 units each—500,000 lbs. per hour—1920 psi discharge pressure.
	FIRST REPEAT	3 units each—500,000 lbs. per hour—1920 psi discharge pressure.
3	Original Purchase	6 units each—405,000 lbs. per hour—1755 psi discharge pressure.
	FIRST REPEAT	3 units each—405,000 lbs. per hour—1755 psi discharge pressure.
4	Original Purchase	1 unit—372,000 lbs. per hour—550 psi discharge pressure.
	FIRST REPEAT	3 units each—200,000 lbs. per hour—1073 psi discharge pressure.
5	Original Purchase	6 units each—95,000 lbs. per hour—600 psi discharge pressure.
	FIRST REPEAT	30 units each—153,000 lbs. per hour—765 psi discharge pressure.
	SECOND REPEAT	3 units each—153,000 lbs. per hour—765 psi discharge pressure.

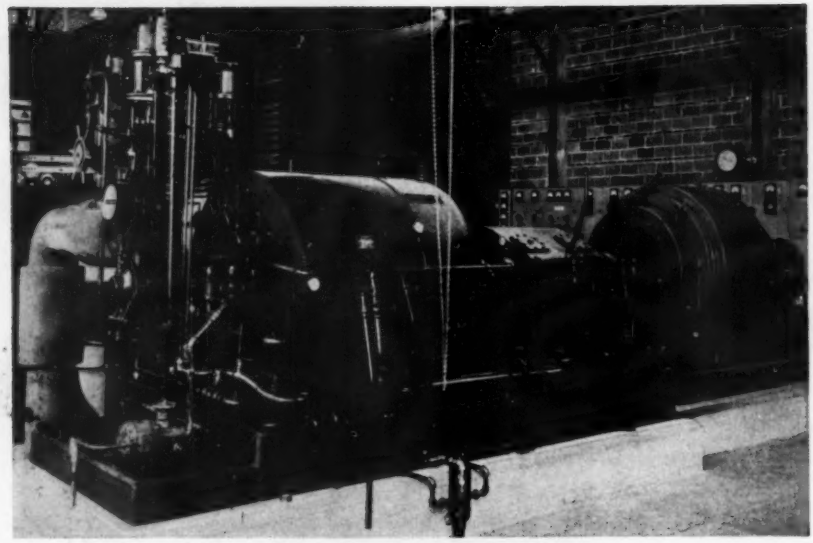
MAKE YOUR NEXT BOILER FEED PUMP A "PACIFIC"
... THERE'S ONE FOR EVERY SERVICE!
call or write the nearest Pacific Office

PACIFIC *Precision Built* **PUMPS**

Pacific Pumps inc.
ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIFORNIA
Export Office: Chanin Bldg., 122 E. 42nd St., New York
Offices in All Principal Cities

BF-8



Proved Turbine Economy

AT NARRAGANSETT BREWERY

For the past twenty years this Rhode Island brewery has been growing — and incidentally proving out turbines in its plant.

The first Terry Turbine was bought in 1936 and enabled the brewery to take full advantage of power generation as a by-product of its process steam.

One of the latest Terry Turbines installed in this plant is shown above. It is a 1000 kw mixed-pressure bleeder condensing turbo-generating unit. Initial steam is 265 pounds with 70 degrees superheat. Process and heating steam is bled at 22 pounds. Any steam not needed for process, passes through the low-pressure stages to the condenser. So if there is an excess of low-pressure steam from the high-pressure section of the turbine or from other sources, it is automatically admitted to the turbine and converted into power.

With other Terry units it provides great flexibility in power available, full stand-by capacity, low cost power and excellent automatic heat balance with ample clean steam, at low pressure, for such functions as kettle boiling, washing, bottling and heating.

Evidently these Terry Turbines have performed economically — altogether six were bought in 1936, 1940 and 1946.

A Terry installation may be as profitable for you as in this plant. We will be glad to discuss the possibilities with you.

TERRY

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT 1187

"For high dust collection efficiency CONSIDER THESE FACTS!"

95% to 99% REMOVAL

Your specific needs determine the exact percentage of fly ash removed by a Research Corporation Cottrell Precipitator.

LOW DRAFT LOSS

The pressure drop between inlet and outlet of the Cottrell is extremely low, averaging *only a few tenths of an inch of water.*

DURABILITY

Low velocities hold abrasion to a minimum.

ANY CAPACITY

Cottrell precipitators have been used successfully with both small boilers and the very large boilers developed in recent years.

OTHER APPLICATIONS

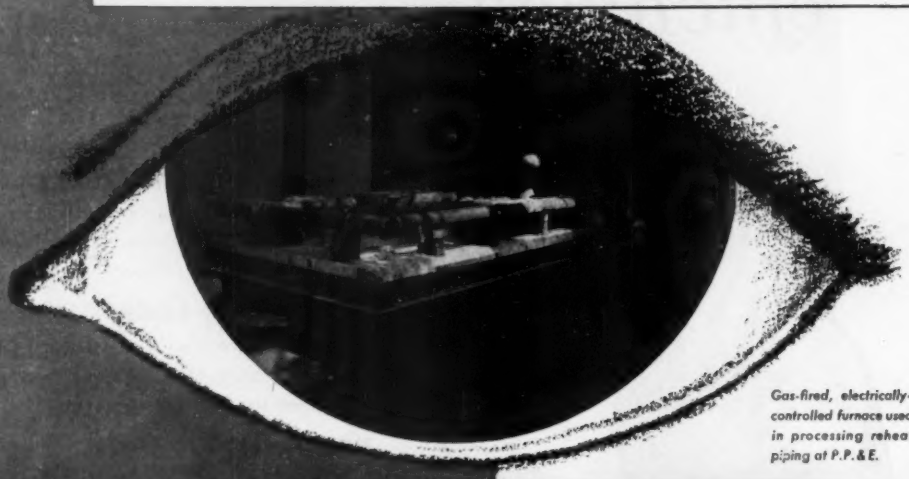
Cottrell precipitators have wide application in the recovery of other materials such as acid mist, blast furnace dust, sodium salts, fluid catalyst and valuable metals from smelters.

YOU GET all these important advantages PLUS Research Corporation's 38 years of experience in the field of electrical precipitation. Every Cottrell installation is individually engineered to do the most efficient job. For more facts about Research-installed Cottrells, send for Bulletin 500.

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois

Looking at REHEAT



Gas-fired, electrically-controlled furnace used in processing reheat piping at P.P.&E.

Through Experienced Eyes

Proper piping is essential in order to realize the benefits inherent in reheating steam to higher temperatures—increased volume per pound of water evaporated . . . reduced condensation in lines, casings, cylinders, etc. . . . improved BTU output . . . better fuel economy.

Remember when 750° F. was thought to be a high reheat temperature? Even then P.P.&E. was ahead of the needs in piping that would carry the load. As the trend toward higher temperatures continued, P.P.&E.'s experience accumulated.

That's why the conditions encountered in present-day reheat temperatures over 1000° F. are thoroughly understood by P. P. & E. engineers—and why adequate materials, design know-how, methods of treating and fabricating, and testing procedures are available.

Look to Pittsburgh Piping and Equipment Company for the experience, and the leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

P. P. & E. Products

Carbon Steel Piping	**Forged Piping Materials**
Cast Iron Fittings	**Headers**
Cast Steel Fittings	**Manifolds**
Chrome-Moly Piping	**Pipe Bends**
Copper Piping	**Stainless Steel Piping**
Corrugated Piping	**Van Stoning**
Creased Bends	**Valves**
Expansion Bends	**Welding Fittings**
Flanges	**Welded Assemblies**

Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street—Pittsburgh, Penna.

Woolworth Building, New York
Whitehead Building, Atlanta
Book Tower, Detroit
525 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston

You will find

Worthwhile Savings

with these 6 Harbison-Walker

INSULATING REFRACTORIES

Harbison-Walker Engineering Service will help you with the selection of the insulating refractories best suited for your requirements.

The balanced properties of Harbison-Walker Insulating Brick mean superior performance and dependable service. Light weight, essential to high insulating value and low heat storage, has been attained to the greatest degree consistent with the good mechanical strength necessary for handling and for many furnace structures.

Available in six classes, suitable for service in the temperature ranges indicated above, Harbison-Walker Insulating Brick reduce heat losses, save space, absorb noise, conserve fuel.

H-W 85 and H-W 56 CASTABLES are widely used to great advantage in monolithic structure for refractory insulation.

We will gladly send you bulletins containing data and descriptive information about Harbison-Walker Insulating Brick and Insulating Castables.

HARBISON-WALKER REFRACTORIES COMPANY
AND SUBSIDIARIES
World's Largest Producer of Refractories
GENERAL OFFICES PITTSBURGH 22, PENNSYLVANIA

EXTRA LONG LIFE

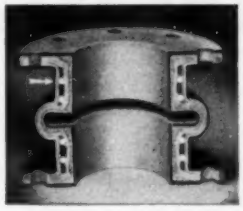
—Because of *Quality* Construction

GARLOCK Rubber Expansion Joints are made of a high-grade rubber compound specially developed by Garlock for long, economical service on pipe lines and other equipment. Furnished in three styles: No. 204 for *Pressure*, No. 205 for *Vacuum*, and No. 206 for *Pressure and Vacuum*. Available in neoprene construction for oil service.

8 Superior Features:

1. Made of high-grade rubber, they do not crack or fracture under repeated flexing.
2. They do not take a permanent set.
3. For pressures from 40 to 125 p.s.i.; and for vacuum of 30 in. of mercury.
4. Suitable for operating temperatures up to 180°F.
5. They do not corrode or erode.
6. They are light in weight and can be installed in a limited space.
7. They require no gaskets between the flanges of the joint and the flanges of the pipe.
8. They do not induce electrolysis.

Garlock "multiple arch" Rubber Expansion Joint.



Arrow points to one of steel reinforcing rings in single arch joint.

Garlock expansion joints are furnished in all pipe sizes from 2" to 72".

Write for Folder.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

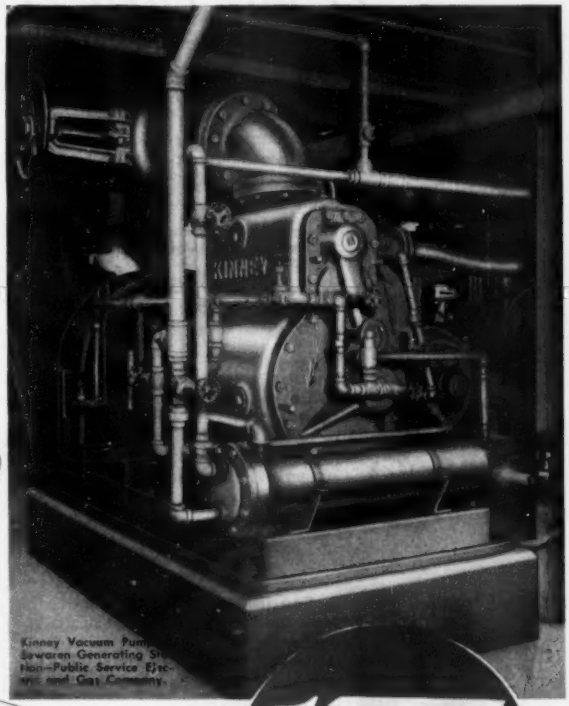
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK RUBBER EXPANSION JOINTS

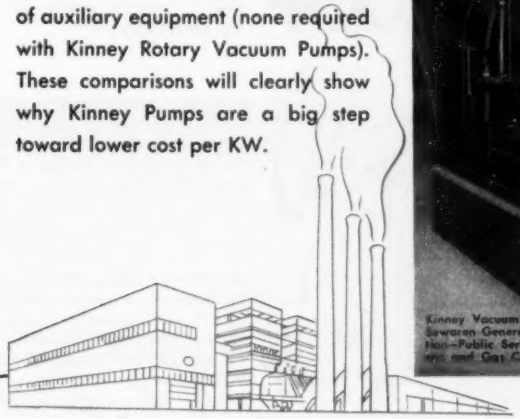
A BIG STEP TOWARD LOWER COST PER KW

WHEN you look at costs, you'll see why so many modern power plants are turning to Kinney Rotary Vacuum Pumps for *complete condenser vacuum control*. The Kinney vacuum system is no "guinea pig": Some of the biggest plants in the power field have had Kinney Vacuum Pumps in service for more than five years. Compare the experience of these plants with the experience of plants using other types of air removal equipment. Compare: **1** costs of installation; **2** costs of equipment; **3** costs of operation; **4** manpower costs; **5** costs of maintenance; **6** costs of auxiliary equipment (none required with Kinney Rotary Vacuum Pumps). These comparisons will clearly show why Kinney Pumps are a big step toward lower cost per KW.

If your plans call for high pressure — high temperature throttle conditions, Kinney Engineers will be glad to show you facts and figures on Kinney Pumps. Kinney Manufacturing Company, 3532 Washington Street, Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Houston, New Orleans, Philadelphia, Los Angeles, San Francisco, Seattle, and in foreign countries.



Kinney Vacuum Pump... Sewaren Generating St... tion—Public Service Elec... and Gas Company.



No doubt there's a power plant nearby where you can observe Kinney Rotary Vacuum Pumps in operation. Write for name of plant nearest you.

Kinney VACUUM PUMPS

BIRD-ARCHER'S COMPREHENSIVE 8 POINT WATER TREATMENT SERVICE

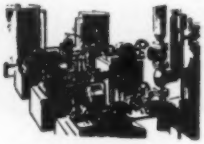
Even if your present water treatment methods **appear** satisfactory, it will pay you to look into Bird-Archer's 8-point water treatment service. Any or all of this comprehensive, efficient service is available to you. Talk to your Bird-Archer representative about it next time he calls. Or, write us now to arrange a consultation. No obligation, of course.

What Bird-Archer Does

1. Surveys Plant—Bird-Archer makes a complete study of plant operation involving the use of water or steam . . . checks present equipment and past performance.

2. Studies All Available Water — Starting at the source, Bird-Archer makes exhaustive analyses of water supplies.

3. Develops Treatment and Control Systems—On the basis of these comprehensive studies, Bird-Archer develops a complete system of treatment and control, including necessary operational changes.



4. Specifies Equipment that May Be Necessary — Bird-Archer determines whether installation of additional equipment will be helpful . . . analyzes benefits to be derived.

5. Furnishes Proper Chemical Treatments When Required—For more than a half century, Bird-Archer has manufactured specifically formulated treatments to solve individual problems.

6. Instructs Plant Staff—Plant personnel is carefully instructed by experienced technicians in the application of treatment and control . . . teaches simple, accurate test procedures.

7. Makes Periodic Check-Ups—To make certain that the recommended system is providing the best possible results, a Bird-Archer Service Engineer makes regular, personal check-ups.

8. Offers a Laboratory Service for Scientific Analysis—Modern Bird-Archer laboratories, staffed by trained chemists, specialize in water analyses and research...check accuracy of plant control.

BIRD·ARCHER
WATER TREATMENT

THE BIRD-ARCHER COMPANY, 400 MADISON AVE., NEW YORK 17, N. Y.
PHILADELPHIA • CHICAGO
IN CANADA: The Bird-Archer Co., Limited, 503 McGill Building, Montreal, Canada
IN MEXICO: Calderas y Accesorios, S. A., Amsterdam 291, Mexico, D. F.

BA-389

OPERATION: FLEXIBILITY

A CLEAVER-BROOKS STEAM BOILER GIVES YOU:

✓ **Quick, effortless response to fluctuating steam demands.**

✓ **Equally high efficiency (80%) operating with oil or gas.**

Fluctuating steam loads are no problem when you have a custom-planned Cleaver-Brooks boiler in your plant. Whether your demand is heavy or light, steady or variable, these sturdy heavy-duty boilers respond instantly to your steam needs. Even with loads as low as 30% of rating, Cleaver-Brooks boilers operate with a flat 80% efficiency.

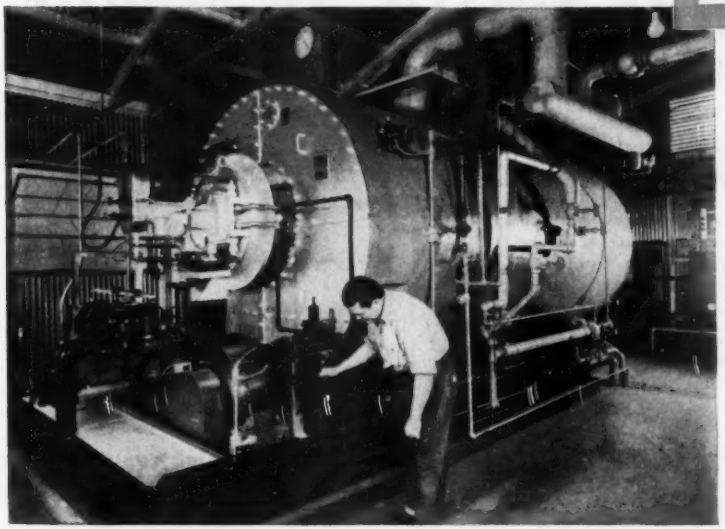
Cleaver-Brooks boilers burn either oil or gas . . . either fuel is properly proportioned to meet your steam demand and need. No banking of fires or loss of valuable heat during low load periods. You benefit with lower fuel bills, less maintenance, reduced operating costs.

If you are considering a change in your present boiler plant—think about flexibility — and get the complete facts about Cleaver-Brooks custom-planned boilers. Cleaver-Brooks self-contained boilers 15 to 500 HP, 15 to 250 lbs., p. s. i. — oil, gas, combination oil and gas firing. CLEAVER-BROOKS COMPANY, 332 East Keefe Avenue, Milwaukee 12, Wisconsin.

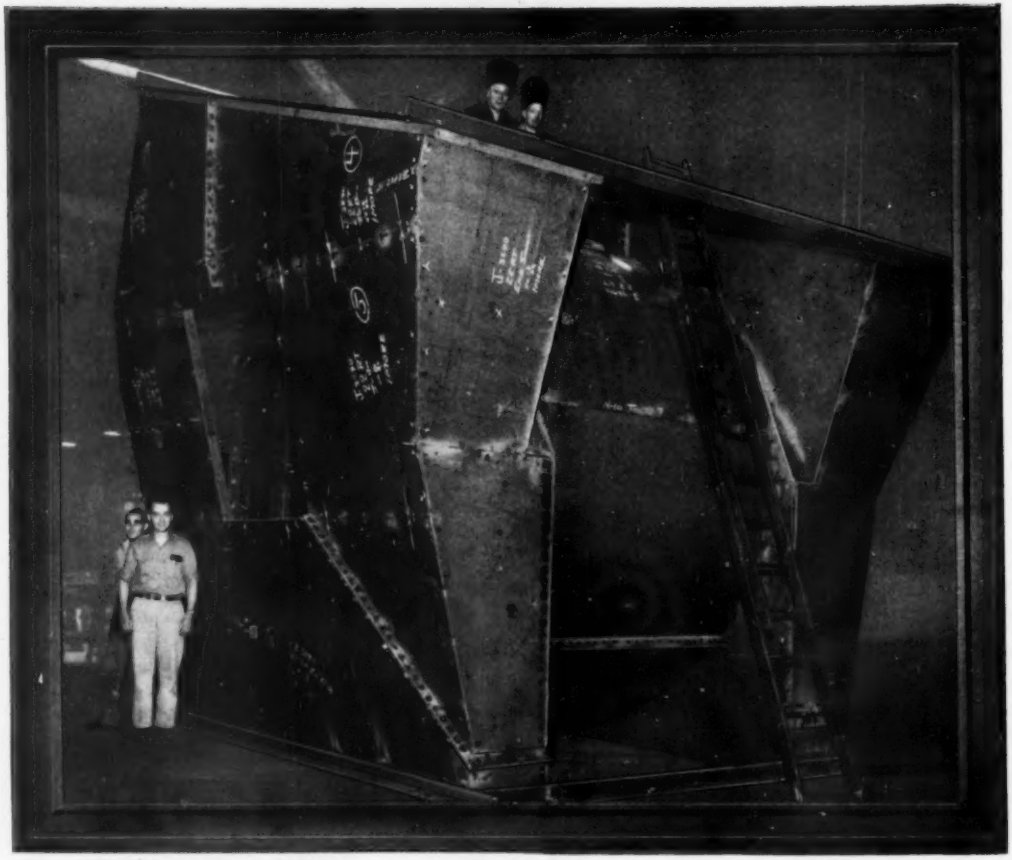
Cleaver-Brooks

STEAM BOILERS

the first and finest of their class



Write for a Cleaver-Brooks Steam Boiler Catalog.

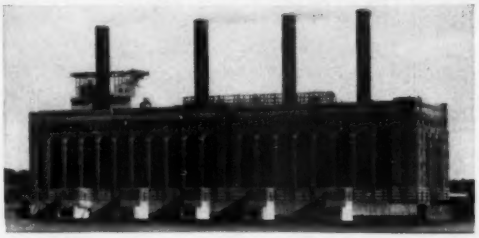


J-3290 Was Quite an Order

CUSTOMER: Central Illinois Light Co.
SERVICE: Power Plant Induced Draft
SIZE: No. 22 RT — 38,278 Pounds
CAPACITY: 330,000 C.F.M. at 325° F.

Photographed above is one of the largest induced draft fans in the world under construction in the Clarage plants. This heavy-duty fan equipment now serves a 600,000-pound boiler at Central Illinois Light Co., Peoria, Illinois.

To date over 3,000 power plants are Clarage equipped. If you are looking for the *utmost in performance and dependability*, it certainly will pay you to consult with us.



CLARAGE
—HEADQUARTERS for Air Handling and Conditioning Equipment

CLARAGE FAN COMPANY
KALAMAZOO, MICHIGAN

Sales Engineering Offices in All Principal Cities

WHY seat misalignment doesn't cause this Darling Valve to leak!

NO gate valve body ever made is entirely immune to distortion caused by line stresses and temperature changes. Yet even slight distortion can throw the seats out of alignment—probably the most common cause of leaky valves and costly replacement.

That's one reason why Darling gate valves, with their unique wedging principle combined with fully revolving double discs and parallel seats, have the jump on other valves. They easily, *automatically* adjust for valve body distortion, cinching tight, leak-proof closure without destructive strong-arm tactics. Most important, you avoid costly down-time and repeated maintenance headaches.

But that's not all! Actually, this Darling principle offers several other equally important time-and-money-saving advantages. In plant after plant they add up to trouble-free performance and longer service life with a very minimum of attention.

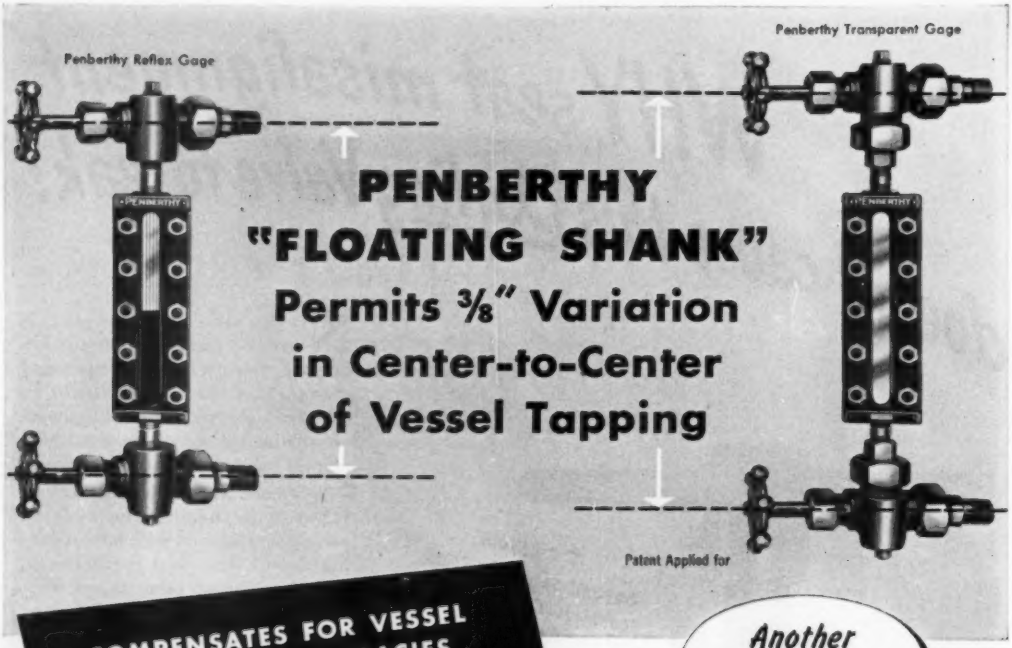
GET ALL THE FACTS

Send for descriptive cast steel valve Bulletin No. 5003.

DARLING VALVE & Manufacturing Co.
WILLIAMSPORT 8, PA.

NOTE: *Darling gate valves are made in a wide range of sizes, types and constructions, including solid and slotted taper-seat wedge types, for all kinds of normal and corrosive services in pressures up to 1500 pounds.*

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN



COMPENSATES FOR VESSEL TAPPING INACCURACIES

•

SAVES INSTALLATION TIME

•

REDUCES GAGE STRESSES

Another **PENBERTHY** *First*

An important new feature now available on all Penberthy drop forged steel gage valves is the "floating shank" . . . an improvement that has money-saving advantages to many users of liquid level and water gages.

The "floating shank" compensates for inaccuracies in the center-to-center distance of the tapped holes in the vessel on which the gage is mounted. The variation can be as much as 3/8". It provides a mounting flexibility not elsewhere obtainable . . . it saves time during installation of the gage . . . it eliminates stresses that are often induced during mounting.

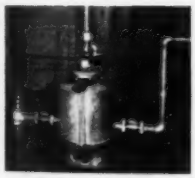
The Penberthy "Floating Shank" can be had at slight additional cost . . . specify it on your next order for Penberthy drop forged steel (or alloy) gage valves.

4449

PENBERTHY INJECTOR COMPANY
DIVISION OF THE BUFFALO-ECLIPSE CORPORATION
Detroit 2, Michigan
Established 1886 *Canadian Plant, Windsor, Ontario*

OTHER PENBERTHY PRODUCTS

PENBERTHY CYCLING JET PUMPS



Automatically operated by air, gas or steam pressure . . . Will pump without clogging any liquid that will flow through pipes. Ask for Bulletin 5030.

PENBERTHY EXPLOSION-PROOF SUMP PUMPS

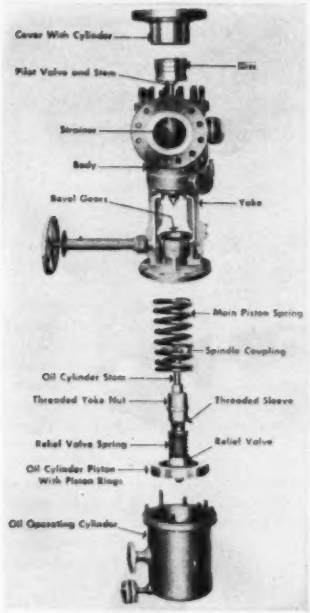
Motor and switch totally enclosed. Underwriter approved for Class I, Group D, and Class 2, Groups E, F and G hazardous location. Made of copper and bronze throughout. Ask for Bulletin 4929.

PENBERTHY EJECTORS

A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Ask for Bulletin 5080.

SK ENGINEERING News

JET COMPRESSORS EASE PEAK LOADS FOR GAS CO.



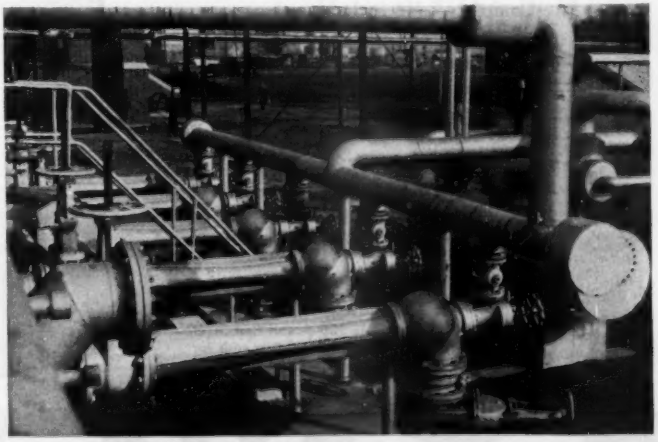
"Turbine insurance" best describes the SK Oil Operated Throttle Trip Valve shown above. Used in the main steam line on large, high pressure turbines it stands guard against failure of lube oil pressure and against turbine overspeed—prevents costly damage. Built to handle the highest pressures associated with present turbines, this type valve is made of materials best suited for high pressure and high temperature operations. It has many advantages. The piston is oil-operated and force for opening or closing the valve is practically unlimited. A handwheel, manually operated, controls a variable orifice which, in turn, controls the oil pressure below the piston in the oil operating cylinder and causes the piston to rise. Should lube oil pressure fail or should the turbine overspeed, the effect of either of these upon the oil pressure in the oil cylinder will cause the valve to trip—shutting off the steam to the turbine. *No literature is available on this valve at present, however, if you desire additional information, contact the company and a representative will call.*

THE illustration shows a typical arrangement of SK Gas Jet Compressors at the plant of The Brooklyn Union Gas Company and indicates how more and more companies are making use of the operating efficiencies and economies offered by these compressors in meeting peak load conditions.

All five gas compressors shown are being used to mix Butane or Propane with atmospheric air and to discharge the mixture against a maximum of 9/10 of a pound back pressure. At installation, the control valves on the suction lines were adjusted for operation at the required heating value. In this case, the Butane or Propane passes from the vaporizer into a header which supplies all five compressors. This gas, at 45 psi gauge, entrains atmospheric air in desired proportion and, once adjusted, operates at a fixed ratio giving constant Btu discharge. A spindle in each nozzle allows adjustment for using Butane or Propane. Each of the units shown has a capacity of 210,000 standard cubic feet of mixed gas per hour at 540 Btu per cubic foot. Control in this installation is manual although SK Gas Jet Compressors can be controlled automatically.

Another advantage of these compressors is the fact that they eliminate the need for a mechanical compressor or blower on the atmospheric air inlet. The plug valve in the L-P line is used to place each compressor in operation and one through five of the compressors can be operated as conditions necessitate. The integral check valves prevent back flow to atmosphere.

For details on SK Gas Jet Compressors, request Bulletin 4-F.



Manufacturing Engineers

(Advertisement)

IN FLOW CONTROL EQUIPMENT,

the BEST *is not too good for you*

Why not take advantage of Powell "know-how" in design, workmanship, and *use of materials?*

The Complete Line includes valves in Bronze, Iron, Steel and the widest selection of Corrosion-Resisting metals and alloys ever made available to Industry.

Quality line throughout "The Line"

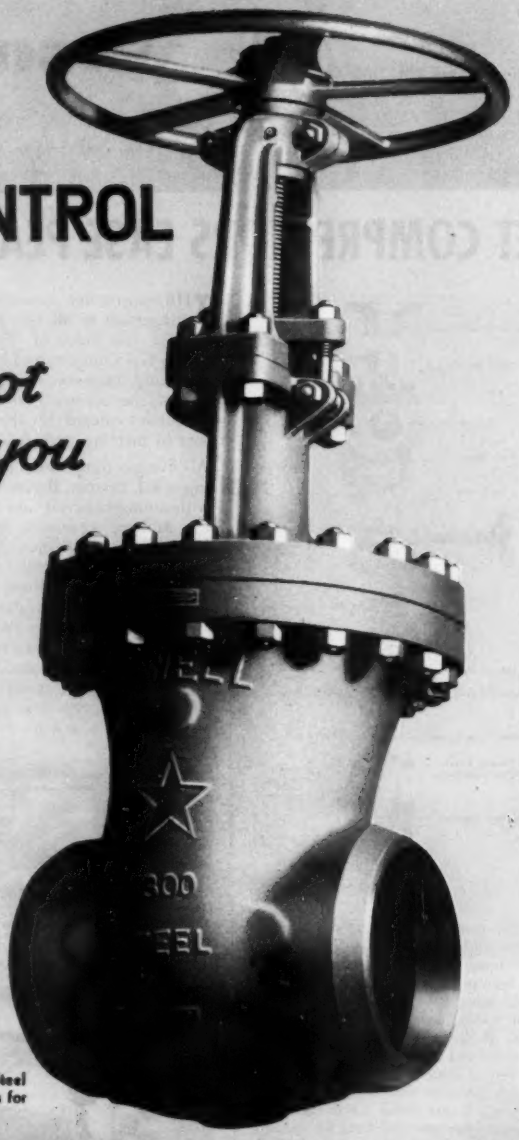


Fig. 3003 W. E.—Class 300-pound Cast Steel O. S. & Y. Gate Valve with welding ends for Power Plant installations.

POWELL

The WM. POWELL CO., 2525 Spring Grove Ave., P. O. Box 106, Station B, Cincinnati 22, Ohio

BIDDLE *Instrument News*

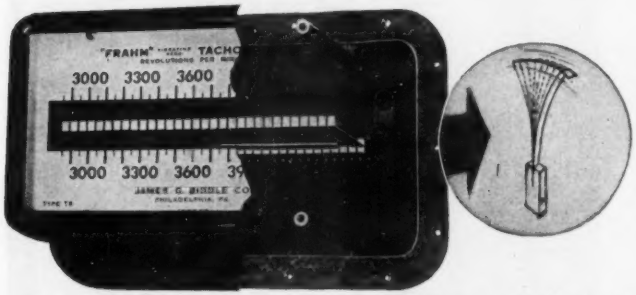
- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

NUMBER 3 OF A SERIES

JAMES G. BIDDLE CO., 1316 ARCH ST., PHILADELPHIA 7, PA.

THE FRAHM® RESONANT REED IS THE "NATURAL" WAY OF MEASURING SPEED

No Oiling • No Maintenance • Imposes No Load on Machine Under Test



The speed measuring device in a Frahm Tachometer is extremely simple. It consists of a set of consecutively tuned spring steel reeds mounted in a case with a scale calibrated in rpms or vpms. The predominantly vibrating reed indicates speed at a glance. The principle is based on the natural phenomenon of resonance—the quality of an elastic body to vibrate vigorously when subjected to small rhythmic impulses at a rate approximating its natural frequency. No rotating machine is absolutely free of vibration. However imperceptible, the vibration can be measured with a Frahm Resonant Reed Tachometer by touch or permanent mounting. (The same principle is used to measure and indicate electric frequency.)

Guaranteed Accuracy

Careful research and many years of practice in the art of manufacturing and tuning reeds enables our craftsmen to guarantee accuracy to within 0.5% of the rated frequency of vibration.

Ranges from 1,000 to 100,000 RPM

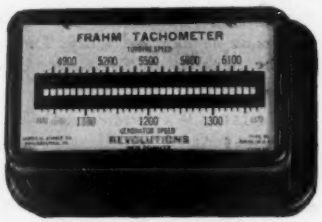
Frahm Tachometers offer dependability and long life for measuring speed or rate of vibration in a variety of ranges from 1,000 to 100,000 rpm or vpm.

NEW DUAL-PURPOSE FRAHM® TACHOMETER

1. Measures Turbine Speeds

2. Measures Generator Speeds

A single row of reeds with a double scale gives the power engineer constant check on both turbine and generator. Available with either 45° or 90° brackets for permanent mounting.

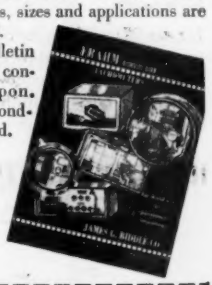


Dimensions: 7¼" x 4⅝" x 4¼"
"Splash-Proof" Case

SEND FOR NEW 16-PAGE BULLETIN

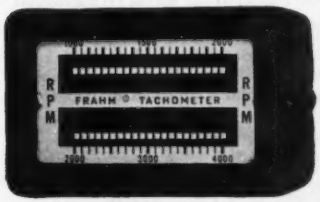
Just off the press, with the latest designs and specifications for Frahm Tachometers. Various shapes, sizes and applications are recommended.

Ask for Bulletin 31-P or mail convenient coupon. Your correspondence is invited.



TOOL-KIT SIZE, TWICE THE RANGE

Miniature FRAHM®—Hand Held or Permanent Mounting



Dimensions: 2⅝" x 1⅝" x 2¼"
Weight: 12 ounces

Type T-22 is a handy tool-kit or pocket instrument with two rows of 21 reeds each. This affords double the rpm range of the popular T-21. These small instruments are built to take rugged handling by production foremen and maintenance men, or may be permanently mounted with 60° or 90° brackets, which we furnish.

JAMES G. BIDDLE CO. Date_____
1316 Arch St., Philadelphia 7, Pa.

Please mail me your new Bulletin 31-P
I am interested in measuring (describe machine):

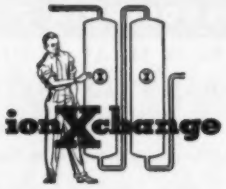
_____

*Name*_____ *Position*_____

*Company*_____

*Address*_____

BLOW-DOWN CUT 100,000 GALLONS PER DAY AT CATERPILLAR TRACTOR CO.



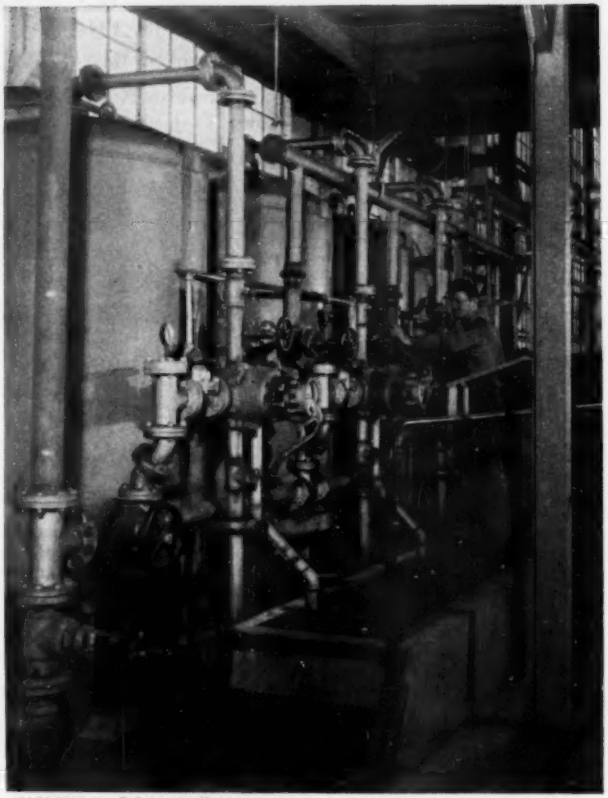
ILLCO-WAY's simplified modern boiler water conditioning system cuts steam costs, boosts efficiency at Caterpillar Tractor Co. plant

"Caterpillar" operates twelve 630 H. P. boilers on de-alkalized water. The boilers can be operated at 200% capacity, or at 1260 H. P.

Use of ILLCO-WAY equipment, shown at right, has reduced blow-downs by approximately one-half of former requirements. Continued use of de-alkalized water is expected to produce even greater blow-down reduction in the future.

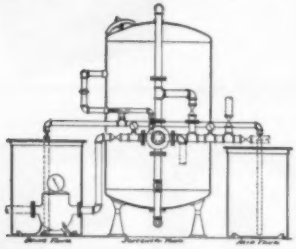
In nine months of operation the savings on make-up water have been very pronounced, Caterpillar reports. During normal operations, an estimated 100,000 gallons per day on make-up water are saved by using ILLCO-WAY equipment, as the result of elimination of excessive blow-down.

ILLCO-WAY De-alkalizing equipment produces water suitably low in alkalinity, reduced in solids content, free of hardness, at a cost comparable to softening. See Sweet's File, Engineering, or write us.



ILLCO-WAY De-alkalizing installation in power plant at Caterpillar Tractor Co., Peoria, Illinois

ILLCO-TEMP SOFTENER...for "zero" soft boiler feedwater without chemical after-treatment



Softener is easily added to hot lime-soda water softener. Unit operates economically and continuously at temperatures as high as 250° F or higher... on waters having a pH as high as 10.5.

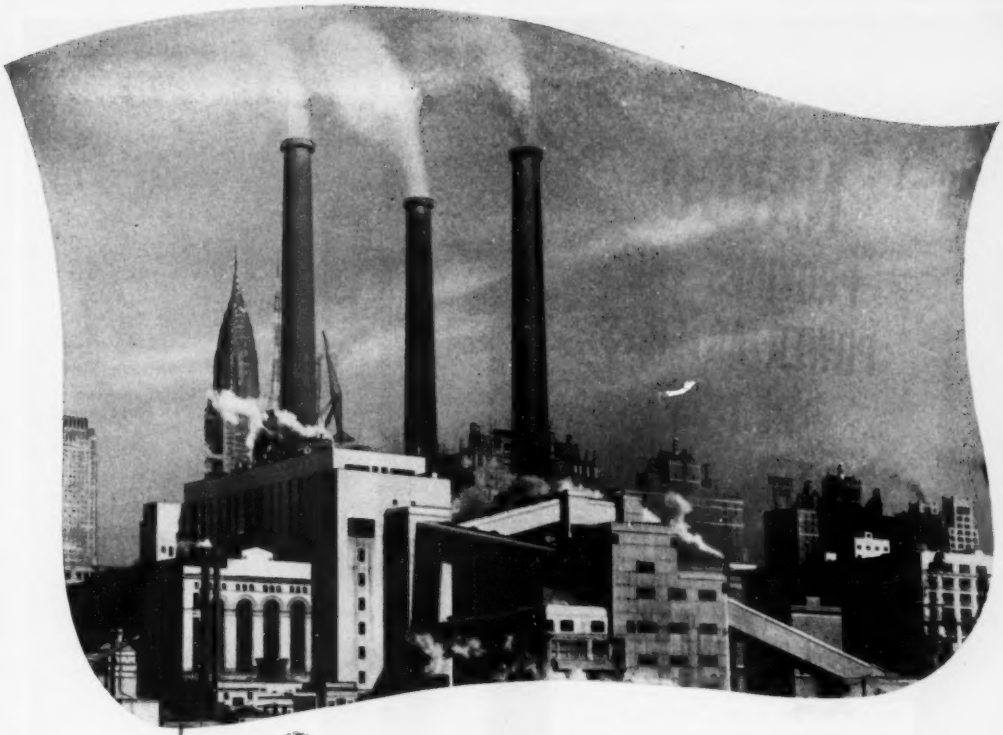
This modern softener removes residual hardness from the effluent of hot or cold lime-soda units—*without chemical after-treatment.* Chemical savings from this alone will normally pay for equipment in less than 2 years. Reduction of effluent from lime-soda units to "zero" hardness produces real operating economies. Scale-forming salts are eliminated. No after-precipitation in the lines, pumps, pre-heaters, or the boilers themselves.

ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

ILLINOIS WATER TREATMENT CO., 853-4 Cedar Street, Rockford, Illinois • 141 East 44th St., New York City

Canadian Distributor: Pumps & Softeners Ltd., London, Ontario



Whatever equipment you prefer, here's the secret of

LOW-COST POWER

When choosing your fuel, always keep these three factors in mind:

1. ***The types available.*** Along the Baltimore & Ohio, you're sure to find the type that exactly meets your needs. The modern mines in this area produce a wide variety of excellent Bituminous.
2. ***Nearness to your plant.*** With its 11,000 miles of track, the B&O offers efficient economic transportation to plants throughout the heart of industrial America.
3. ***Reserves on hand.*** Virtually limitless reserves of power-packed Bituminous lie in the vast B&O territory—a supply that will last for centuries.

For the secret of dependable, low-cost power as related to your specific needs, *ask our man!*

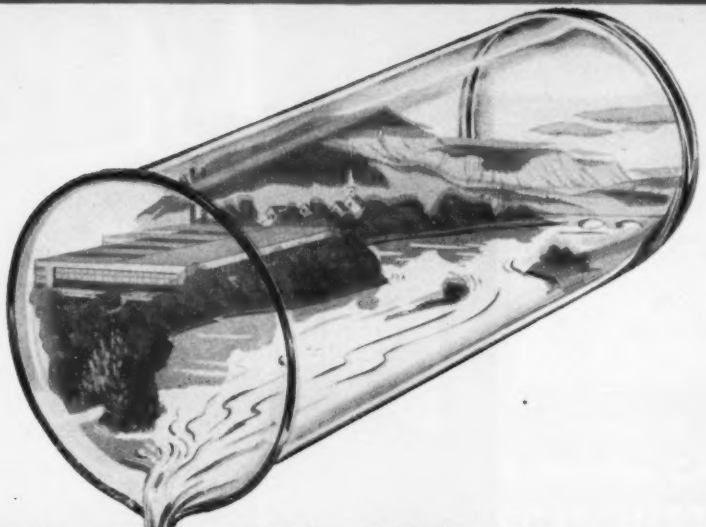
Bituminous Coals for Every Purpose

LINKING 13 GREAT STATES WITH THE NATION — B&O

BALTIMORE & OHIO RAILROAD

Constantly *doing things*—better!

NAVCO
PROVIDES THE
POWER ARTERIES
IN THIS
CENTRAL STATION
Just another modern High Pressure-High Temperature Power Plant in the Southwest that has DEPENDABLE Piping.
NAVCO
NAVCO PIPING
NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.
NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI



SILICA-FREE BOILER WATER without Evaporation . . .

From Any Raw Water Supply

The AMBERLITE deionization process gives you the water you *need* from the water you *have*. Regardless of water analysis, you can obtain highest quality boiler-feed water, *without* evaporation. Total ionized solids can be reduced to less than 0.1 p.p.m. Silica content, CO_2 content and hardness are virtually zero.

You'll cut costs, too, with AMBERLITE deionization. Equipment cost is small compared to evaporators. Operating cost is lower. Corrosion of piping is reduced through removal of CO_2, which is never completely accomplished by evaporation. An adequate supply of conditioned water is assured despite wide variation in the quantity required.

For improved water conditioning at lower cost, choose either an AMBERLITE multiple bed installation or a single bed unit. For further details, write today for your copy of our new four-page bulletin on AMBERLITE Ion Exchange Resins. Then discuss AMBERLITE deionization with your consulting engineer or water conditioning equipment manufacturer. He will be glad to help you select the right combination to suit your specific needs.

Newest word in water-treating

MONOBED DEIONIZATION

One pass through one column of AMBERLITE mixed anion and cation exchangers can transform raw water into deionized, silica-free water. Ask for our new 12-page booklet, "Monobed Deionization."

CHEMICALS FOR INDUSTRY

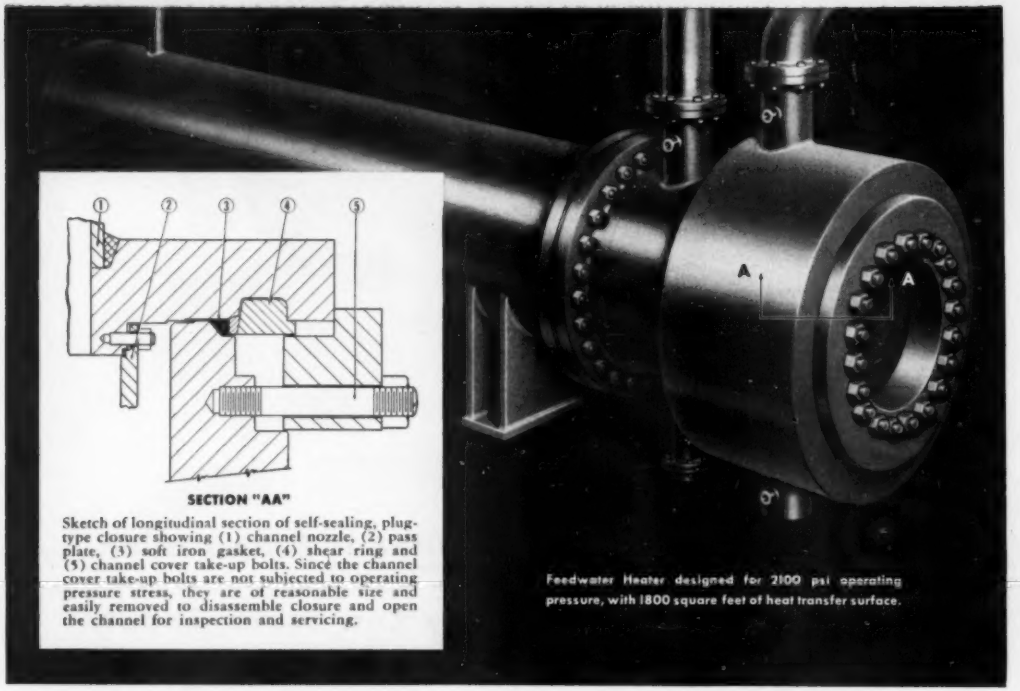
ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square Philadelphia 5, Pa.

Representatives in principal foreign countries

AMBERLITE is a trade-mark, Reg. U. S. Pat. Off. and in principal foreign countries.



SECTION "AA"

Sketch of longitudinal section of self-sealing, plug-type closure showing (1) channel nozzle, (2) pass plate, (3) soft iron gasket, (4) shear ring and (5) channel cover take-up bolts. Since the channel cover take-up bolts are not subjected to operating pressure stress, they are of reasonable size and easily removed to disassemble closure and open the channel for inspection and servicing.

Feedwater Heater designed for 2100 psi operating pressure, with 1800 square feet of heat transfer surface.

HIGH PRESSURE FEED WATER HEATERS
Call for A.O. Smith Design Features

Pressures of 1,000 to 10,000 psi are run-of-mill specifications at A. O. Smith!

With feedwater heater pressures exceeding 2,000 psi in power plant planning, A. O. Smith pressure-vessel and heat-exchanger design features find new and extremely important application. For example:

The self-sealing closure illustrated assures a positive seal under pressure. Still, it provides for easy servicing that means low maintenance.

For 77 years, A. O. Smith has been a leading fabricator of steel products and heavy industrial equipment. The first electric, arc-welded pressure vessel ever built was made by A.O.Smith in 1925.

Since that time, A. O. Smith has developed design features and manufacturing techniques that have set the pattern for the entire process equipment field.

Power plant design engineers and consultants are invited to bring their heat-exchanger requirements to one of the finest thermal design groups in this country.

Contact the nearest A. O. Smith office.

77th Anniversary 1874 1951

A.O.Smith

HEAT EXCHANGERS

Boston 16 • Chicago 4 • Cleveland 15 • Dallas 2
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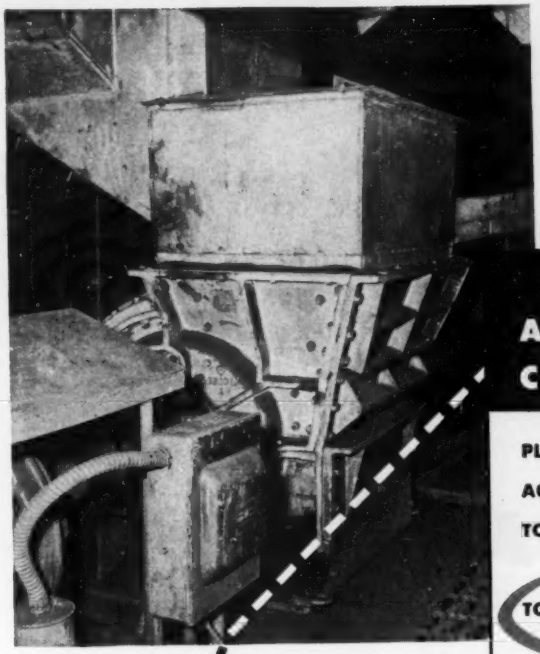
These "CRUSHING" FACTS



Another
American Crusher
CASE HISTORY

PLACE: Illinois Coal Mine

AGE OF CRUSHER: 14 years

TOTAL TONNAGE CRUSHED: 1,472,805

TOTAL COST PER TON: one half of 1¢*

—again prove
AMERICAN CRUSHER performance

* The total cost figure for the 14-year coal crushing operations of the Illinois coal mine, whose American Crusher record is shown above, includes: original cost of crusher (completely depreciated); plus cost of replacement parts; plus maintenance costs; plus interest on original investment (at 3% for 14 years).

But here is the really significant fact: an independent survey of users of American equipment has shown that this performance record is a typical one for Americans—a consistent pattern of high tonnage reduction at remarkably low parts-replacement cost.

Only such features as the exclusive Crushing Ring Design — originated and perfected by American — could reduce coal in power plants and coal mines across the country year after year, ton after ton, for *less than 1¢ per ton.*

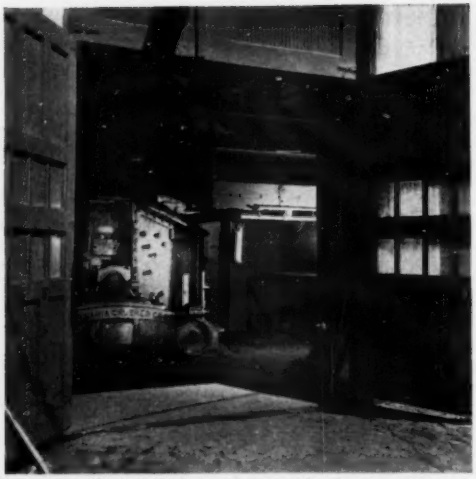
Find out how you may reduce the cost of your own crushing problems. WRITE for detailed information and illustrated literature.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 Macklind Ave.
St. Louis 10, Mo.

Johnson-March system turned off at hammer-mill crusher in a large eastern plant. Note volume of dust. Compare this unretouched photo with the picture at the right.



This unretouched photo shows a Johnson-March system operating at the same crusher. Note absence of dust while coal is being crushed at rate of 250 tons per hour. These systems have proved themselves in many plants. We'll be glad to furnish names and addresses.

STOP COAL DUST

at 1/10 the usual cost!

If you have a dust problem—no matter how large or small—no matter where the dust occurs . . . car dumpers, hoppers, crushers, belt galleries, or coal pile—it can be controlled or eliminated with a Johnson-March liquid diffusion system. Installation is fast, simple, and inexpensive. There is no interference with normal plant operations.

No ducts, no fans and no cumbersome equipment are required. Johnson-March compounds added to water and a carefully engineered spray system do the work. The system is guaranteed effective, but its operation is simple. It costs far less than other types of dust handling systems—in most cases only 1/10 as much. And maintenance costs next to nothing!

Even though you may have a mechanical dust collecting system, it will pay you to investigate a Johnson-March system.

Without cost or obligation, why not have one of our engineers discuss your dust problems with you? Just drop us a line or mail the attached coupon.

THE JOHNSON-MARCH CORP.
1724 Chestnut St., Philadelphia 3, Pa.
Without cost or obligation, I would like to know more about the Johnson-March system of low-cost dust control. P-1

Name .....
Company .....
Address ..... State .....
City .....

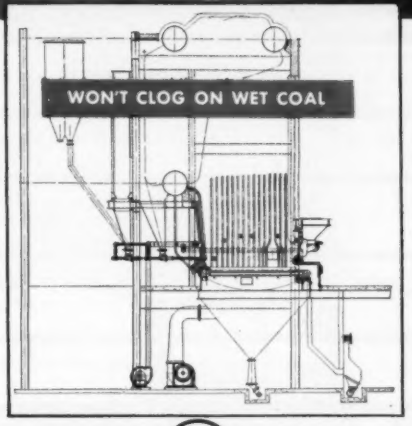
Johnson March

Specialists in Liquid Diffusion

1724 CHESTNUT STREET **Philadelphia 3, Pa.**

TOP EFFICIENCY FROM LOW AND HIGH ASH COALS

PERFECT SPREAD STOKER



Three AE Perfect Spread 2-feeder, travelling grate Stokers recently installed by a leading pharmaceutical manufacturer in the midwest. The boilers, each with a maximum continuous capacity of 60,000 lbs. per hour are Union "A" Type. Efficiency at normal capacity, 83.4%; at maximum capacity, 82.4%. Consulting Engineer, Austin Company.

In the Boiler Room illustrated, the Perfect Spread Stokers were guaranteed to use coal containing either 13,306 B.T.U. or 11,327 B.T.U. per lb. as fired. These two coals have moisture contents of 4.7% and 10.7%, with ash content of 8.2% and 10.1%, respectively. With either coal, practically the same capacity is available but these Perfect Spread Stokers have done even better than predicted. Five different grades of coal have been used to date . . . and all with top efficiency.

Perfect Spread's unique feeder won't clog on wet coal but feeds uniformly—not in slugs—regardless of moisture content. Its engineered cinder return and adjustable overfire air system give comparable results from either low or high ash coals. Its even feed characteristic insures higher CO_2, freedom from smoke puffs, minimum carbon in the ashpit, and less fly ash. Feeders adjustable from 50 to 7,500 lbs. of coal per hour . . . capacities range from 8,000 to 500,000 lbs. of steam per hour. Mail coupon today for full data.

AE

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers

American Engineering Company
2400 Aramingo Ave., Philadelphia 25, Pa.

Gentlemen: We are interested in saving fuel dollars. Kindly send booklet giving full information about Perfect Spread Stokers.

Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....

COMPARISON PROVES the VALUE of VEELOS

the Adjustable V-Belt...

IF you use v-belts you'll be interested in this clear statement of facts about VEELOS, the link v-belt, and endless v-belts.

These 4 reels of Veelos provide up to 316 standard v-belt sizes.

COMPARISON TABLE
VEELOS and ENDLESS V-BELTS

what about...	Veelos V-Belts	Endless V-Belts
ADJUSTABILITY	*Any* length can be provided for *any* v-belt drive due to link construction.	Standard or special lengths must be supplied for *individual* drives.
INVENTORY	MINIMUM INVENTORY. 4 reels can care for every v-belt need in the O, A, B and C widths. No deterioration or obsolescence of spare belts.	LARGE INVENTORY. 316 sizes are required to provide a *complete* stock in the O, A, B and C widths. Spare belts not immediately used will age and deteriorate.
STORAGE	SMALL SPACE. It takes less than 2 square feet of wall or floor space to store 4 reels of easily identified Veelos.	LARGE SPACE. Walls and ceilings are often covered with stocks of endless v-belts. Identifying and maintaining full stocks is difficult and costly.
INSTALLATION	Installs quickly *on any drive* without resetting motor or tearing down outboard bearings.	Necessary to reset motor and tear down drives with outboard bearings.
MAINTENANCY	Belts can be adjusted or replaced without moving the motor.	Sliding or pivoted motor bases are necessary to replace endless v-belts. Belts cannot be adjusted individually.
OPERATING EFFICIENCY	Full power delivery can be maintained because the tension of each belt in a matched set is kept uniform by removing or adding links.	Individual belts cannot be adjusted to maintain uniform tension and provide full power delivery.
LENGTHS	No limitations are imposed by belt length.	Limited by the availability of standard or special belt lengths.

If you would like to learn more about Veelos—how it can save you money and keep your machines producing—write today for your copy of the Veelos Data Book. It's free and full of facts!

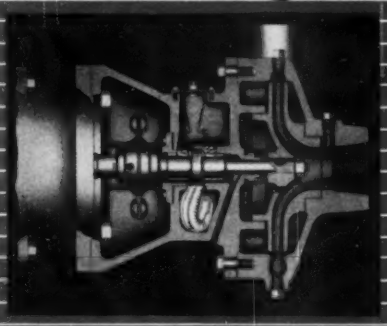
VEELOS
THE LINK
V-BELT

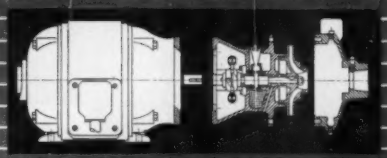
MANHEIM MANUFACTURING & BELTING COMPANY
MANHEIM, PENNSYLVANIA

... ADJUSTABLE TO ANY LENGTH ... ADAPTABLE TO ANY DRIVE

Made in all widths in three types: regular, oil-proof and static conducting. Also double V in A and B. Packaged on reels in 100-foot lengths. Sales engineers in principal cities; over 350 distributors throughout the country. VEELOS is known as VEELINK outside the United States.

B & G PUMPS *Challenge Comparison*





By removing a few bolts, the B & G Series 1522 separates into three parts—easy to service.

When you check into these design features, it's easy to understand why B & G Series 1522 Pumps are making performance records!

First: Leak-proof Mechanical Seal—ends stuffing box troubles.

Second: Spring-type flexible coupling—contributes to unusually quiet operation.

Third: Hydraulically balanced impeller.

Fourth: Easily serviced. Removal of a few bolts permits separation into three parts.

Fifth: Interchangeable parts. The bearing bracket sub-assembly, including shaft and sleeve bearings, is manufactured to close tolerances and is interchangeable in all B & G 1522 Pumps.

Sixth: Shaft alignment maintained by oil-lubricated, high grade bronze sleeve bearings.

Seventh: Standard motors—easily obtainable from motor manufacturer's stocks.

Eighth: With all these features, B & G Pumps are *competitively priced!* Don't delay—get the facts *now* on B & G Centrifugal Pumps.

B & G Series 1510-15 Centrifugal Pump

B & G Series 1531 Centrifugal Pump

Send today for catalogs giving descriptions and selection data for B & G Centrifugal Pumps.

Heat Exchangers . . . Water Heaters
Pumps . . . Refrigeration Equipment
Forced Hot Water Heating Systems

Hydro-Flo* **PRODUCTS**

BELL & GOSSETT COMPANY

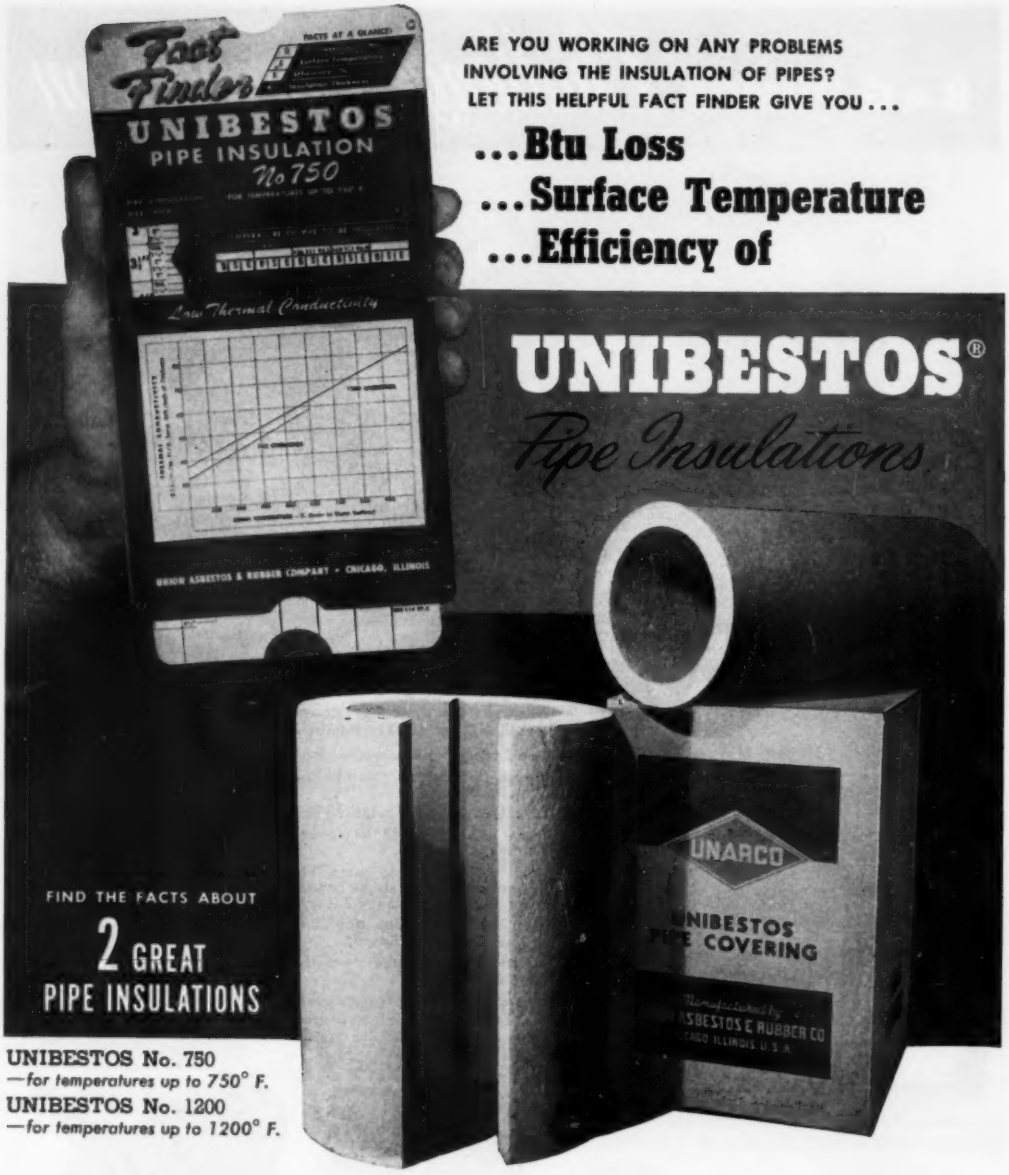
Dept. BZ-36, Morton Grove, Ill.

Canadian Licensee: S. A. Armstrong Ltd., 1600 O'Connor Road, Toronto, Canada

*Reg. U.S. Pat. Off.

ARE YOU WORKING ON ANY PROBLEMS
INVOLVING THE INSULATION OF PIPES?
LET THIS HELPFUL FACT FINDER GIVE YOU . . .

. . . Btu Loss
. . . Surface Temperature
. . . Efficiency of



FIND THE FACTS ABOUT
2 GREAT PIPE INSULATIONS

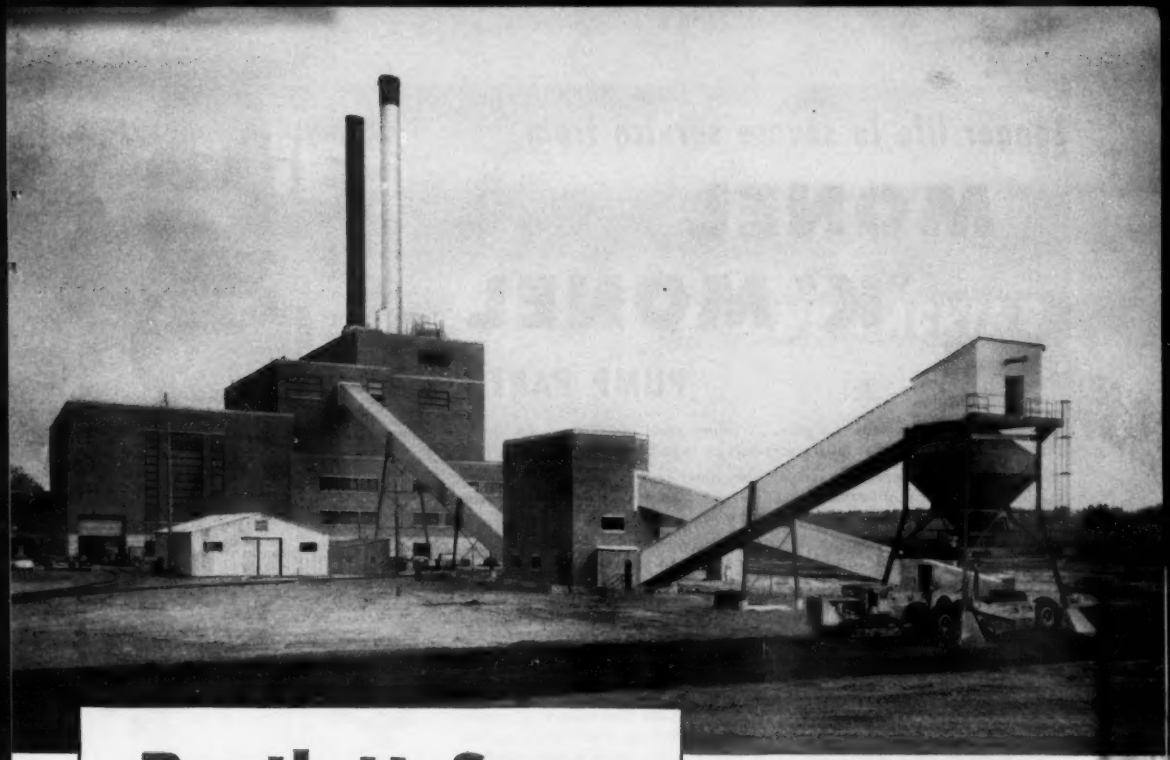
UNIBESTOS No. 750
—for temperatures up to 750° F.
UNIBESTOS No. 1200
—for temperatures up to 1200° F.

UNARCO

WRITE today, on your company letterhead, giving your title or function. A "Fact Finder" will be sent to you together with complete information on UNIBESTOS Pipe Insulations No. 750 and No. 1200.

UNION ASBESTOS & RUBBER COMPANY

DEPT. 1819 • 332 SOUTH MICHIGAN AVENUE • CHICAGO 4, ILLINOIS



General View of Kramer Power Station
Nebraska Public Power System
Sargent and Lundy
Consulting Engineers

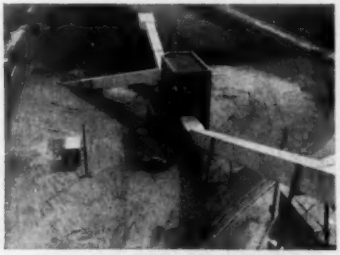
Bartlett-Snow coal handling at Bellevue

● The illustration above shows the first 90,000 KW unit of a plant which is to be extended into a 180,000 KW station. All coal handling equipment including the track and reclaiming hoppers and grillage, duplex feeder, belt feeder, conveyors, galleries and all supporting structures were detailed and fabricated in our shops, and installed by us, to Sargent and Lundy's specifications. For maximum efficiency and affixing unit responsibility, let the Bartlett-Snow coal handling engineers, with their long experience and complete facilities, work with you on your next job.

DESIGNERS
ENGINEERS

BARTLETT-SNOW
CLEVELAND 5, OHIO

FABRICATORS
ERECTORS



View Showing Track Hopper, Reclaiming Hopper, Breaker House and Storage Yard

Belt Feeder in Pit Connecting Reclaiming Hopper into Main Conveying System

Longer life in severe service from

MONEL
"K" MONEL
PUMP PARTS

Corrosion, erosion, wear, fatigue . . . pump parts must stand up to *all* these destructive forces if satisfactory service is to be achieved.

In particular, where corrosive liquids must be handled . . . salt water, crude oil, chemical solutions . . . the selection of proper materials often spells the difference between weeks and *years* of service.

Leading makers and users of pumping equipment have found that pump life can be greatly extended, often tripled and quadrupled, when vulnerable parts are made of *Monel*® or *"K"*® *Monel*.

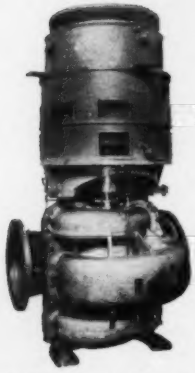
These two INCO alloys are highly resistant to corrosion by salt water and most commonly-encountered industrial chemicals. In addition, they possess strength and hardness equal to that of structural steel. Both alloys are machinable, and are produced in standard mill forms. Moreover, Monel is readily castable.

"K" Monel differs from *Monel* in that it may be heat-treated to attain maximum properties, either before or after machining. This feature makes *"K" Monel* an ideal metal for shafts, sleeves, and other highly stressed machine members, while *Monel* is at its best in impellers, valve parts, strainers, and piping.

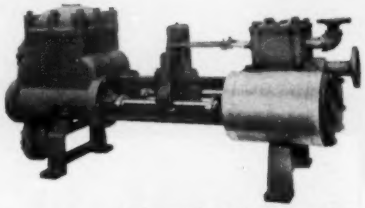
The International Nickel foundry at Bayonne, N. J., has been casting Monel pump parts for more than 40 years. Among recent technical advances is an improvement in the as-cast surface of sand castings. Shrouded impellers, for example, are now cast with a surface so smooth that pump manufacturers report up to 75 per cent less labor time required for hand filing. The INCO foundry also produces centrifugal castings for shaft sleeves, cylinder liners and pump rings.

The supply of nickel alloys has necessarily been diverted to meet defense needs. However, firms now in defense work *and* those planning for future production will be interested in "How to Get Longer Service From Your Pumps". Write to INCO for your copy.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

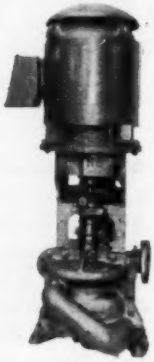


24-inch main condenser circulating pump with a capacity of 15,000 g.p.m. at 25-foot head. Shafts are heat-treated "K" Monel.



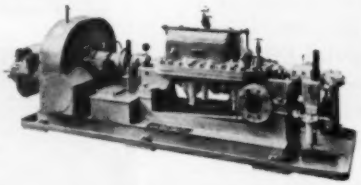
Horizontal duplex low-pressure feed pump, 7½ in. by 5 in. by 10 in. Operating pressure is 250 psi. Piston rods and valve rods are Monel.

3-inch main condensate pump handling 225 g.p.m. at a head of 180 ft. Impellers are Monel, cast at Inco's Bayonne foundry.



2-inch condensate and drain transfer pumps, handling 100 g.p.m. at a 140-ft. head. Cast Monel impellers were produced by Inco's Bayonne foundry.

All pumps illustrated were manufactured by: WARREN STEAM PUMP COMPANY, INC. Warren, Mass.



2½-inch, six stage feed pump, driven by a 210 H.P. turbine. Pump delivers 300 g.p.m. of feed water at a discharge pressure of 725 psi, equivalent to a head of 1770 ft. Shaft sleeves are Monel. Impellers are cast Monel, produced by Inco's Bayonne foundry.

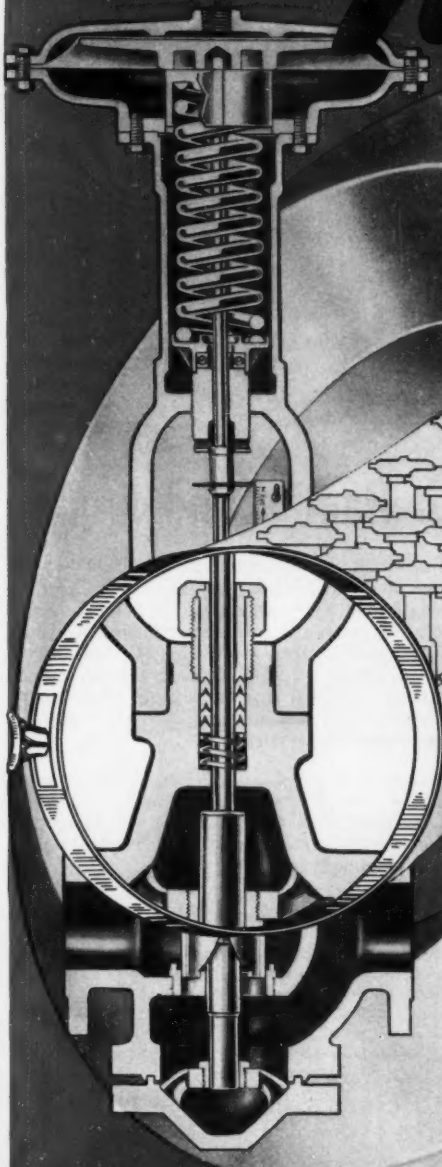
EMBLEM OF SERVICE
INCO
TRADE MARK

MONEL . . . for Minimum Maintenance

FISHER®

Teflon

V-RING PACKING



. . . LEADING THE MARCH TO BETTER DIAPHRAGM MOTOR VALVE PERFORMANCE

Proved by many months of field service, Fisher Teflon V-Ring Packing features:

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- Used on wide range of pressures without appreciable change in friction values.
- Elimination of maintenance and adjustment.
- No valve stem lubricators required.
- Chemically inert to all fluids up to 450° F.

Fisher Teflon V-Ring Packing is now standard equipment on all Fisher Diaphragm Motor Valves.

Bulletin E-200 gives complete details.

*Teflon is the trade name of E. I. Du Pont de Nemours & Co.

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...Easy to Handle and Apply

Kaylo Heat Insulation is easy to handle and apply—in all sizes, shapes and thicknesses—because of its high structural strength and light weight. This remarkable combination of high strength and light weight makes possible speedier application. It provides for units of greater size which permit larger surfaces to be covered faster. With these combined features, Kaylo Heat Insulation gives exceptional ease of handling—offers substantial savings in application costs.

Kaylo Heat Insulation is a hydrous calcium silicate (not glass) with a wide effective temperature range—up to 1200°F. It is inorganic and insoluble in water, incombustible and retains its dimensional stability in long service under severe conditions.

KAYLO PIPE INSULATION is made to Simplified Dimensional Standards of thicknesses and diameters. Coverings are sectional for tube and pipe sizes ¼" to 12"; tri-segmental up to 23"; quad-segmental up to 41"; K-segmental (18" wide segments) up to 72" in diameter.

KAYLO HEAT INSULATING BLOCK is made in all standard sizes and thicknesses from 1" to 6" for flat surfaces and for vessels larger than 60' in diameter; curved block 18" wide for smaller vessels.

SEE OUR CATALOG IN SWEET'S FILE

For complete details on Kaylo Heat Insulation, write Dept. N-191, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

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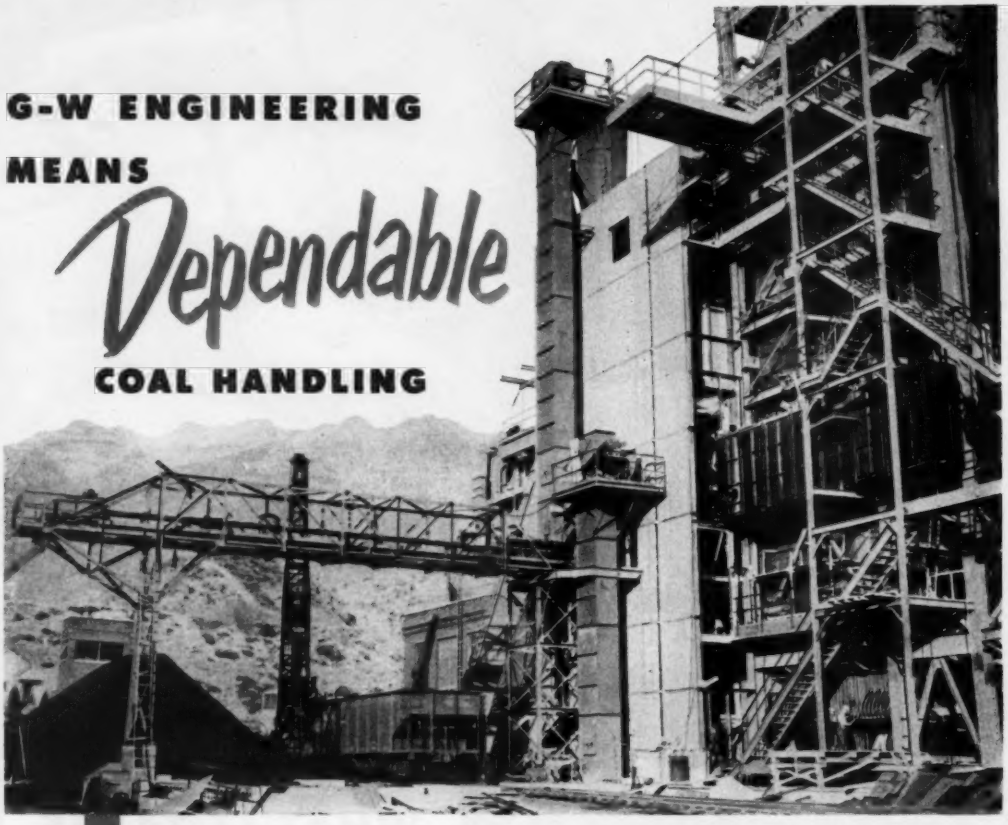
G-W ENGINEERING MEANS

Dependable

COAL HANDLING



The Gifford-Wood coal handling system at the Orem steam electric station of Utah Power & Light Company is designed to handle run-of-mine bituminous coal at 100 tons per hour from dual track hoppers to ground storage, or to overhead storage bins for automatic delivery to boilers. Coal handling is automatic . . . economical . . . completely dependable. The installation, protected by electrical interlocks, is a perfect example of the rugged design and flexibility that can be built into the operation of a well designed power plant.

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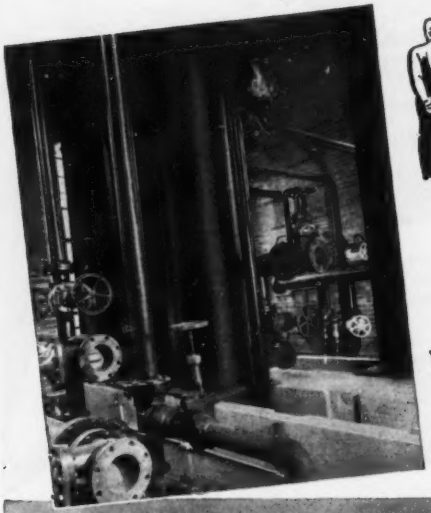
Dirty Water can't "Shut-down"...

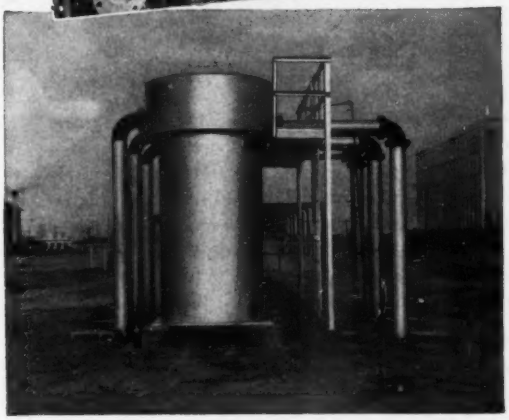
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

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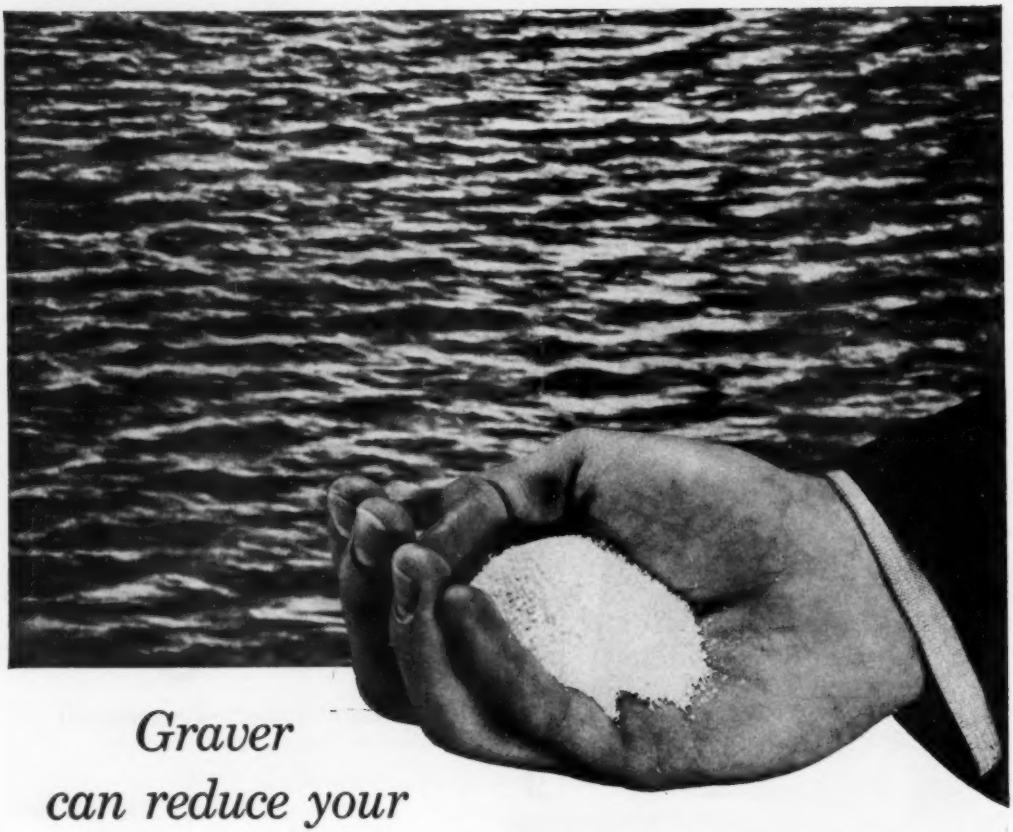

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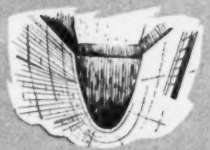
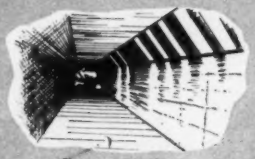
WHERE TO USE LUMNITE IN POWER PLANTS

Steel Stack Linings

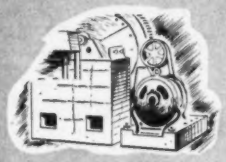
Ash Pit and Cinder Catcher Linings



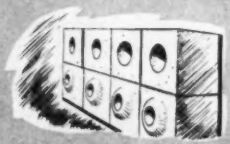
Coal Bunker Linings



Flue and Duct Linings

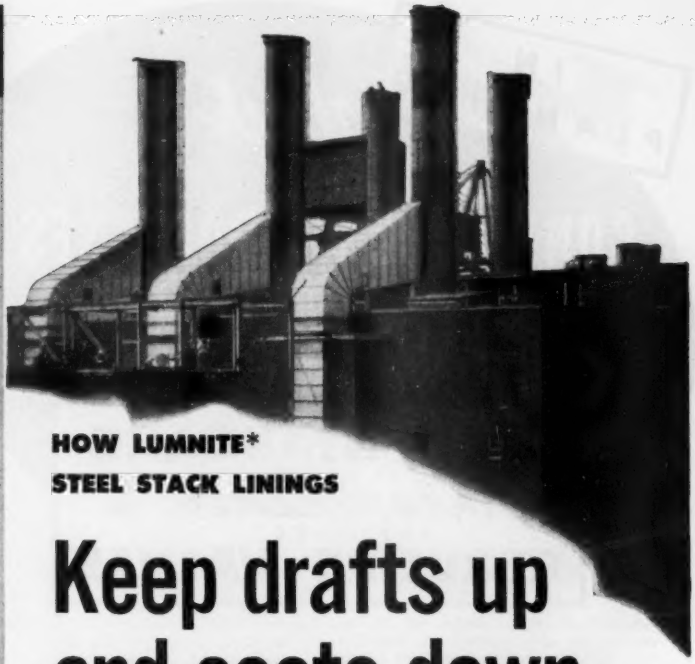


Overnight Structural Concrete



Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job, cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meet different temperature and insulation needs are made by manufacturers of Refractories, sold by their distributors.



HOW LUMNITE*
STEEL STACK LININGS

Keep drafts up and costs down...

Drafts will stay up in these five National Tube Company steel stacks. Smooth, jointless Lumnite refractory concrete linings offer less resistance to gases, prevent "breathing," and their insulating qualities keep gas temperatures high.

The initial cost of the lining was low. It was shot over a reinforcing wire mesh by a concrete "gun." Upkeep, if experience proves anything, will be kept to a minimum. A monolithic lining of Lumnite has no small parts or joints to break loose.

If repairs are ever necessary, they'll cost little in money . . . or outage time. Lumnite calcium-aluminate cement reaches full service strength in 24 hours, or less.

The stacks are protected against attacks of corrosive condensates. Breeching linings withstand the abrasive action of high-velocity gases and fly ash.

Stacks are just one profitable use for refractory concrete made with Lumnite. With suitable aggregates it is ideal for baffles, arches, door linings . . . virtually anywhere heat is a problem and a monolithic refractory would be useful.

Write for our descriptive booklets. Lumnite Division, Universal Atlas Cement Company, (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

* *"Lumnite" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

P-L-43

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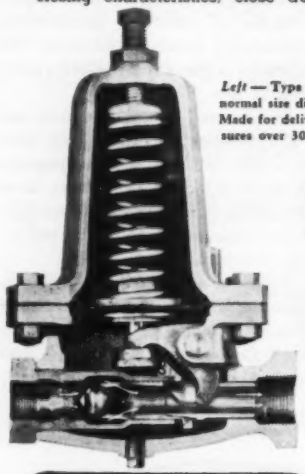
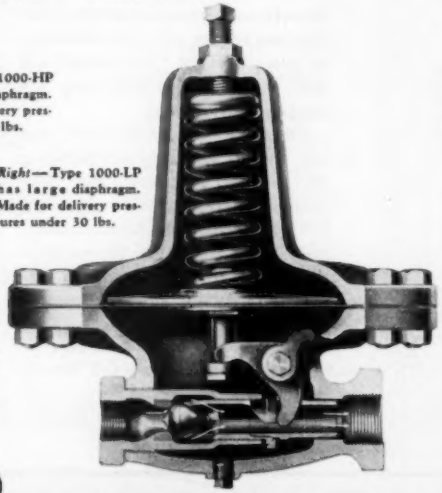
Streamlined flow of steam, air, oil, etc., around the inner valve is an immediate solution to the important need of dependable control under varying loads.

Continuous processes can be dependably protected against slow downs, failures, and maintenance ordinarily due to valve inefficiencies. The STREAMLINED "1000" Valve with ample capacity, tight closing characteristics, close delivery pressure control, and with a wide range of adjustment makes possible speedier production, smooth operation and no spoilage.

You get straight line flow which eliminates turbulence so that at all times you are easily able to meet peak demand and yet hold the reduced pressure constant at the same time. For the complete facts write for Bulletin "1000."



Left — Type 1000-HP normal size diaphragm. Made for delivery pressures over 30 lbs.



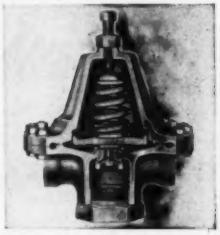
Right — Type 1000-LP has large diaphragm. Made for delivery pressures under 30 lbs.

CASH STANDARD CONTROLS.. VALVES

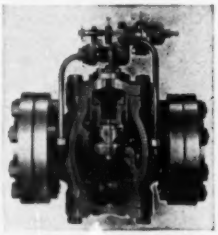
A. W. CASH COMPANY
DECATUR, ILLINOIS

OTHER VALVES *from the* CASH STANDARD LINE

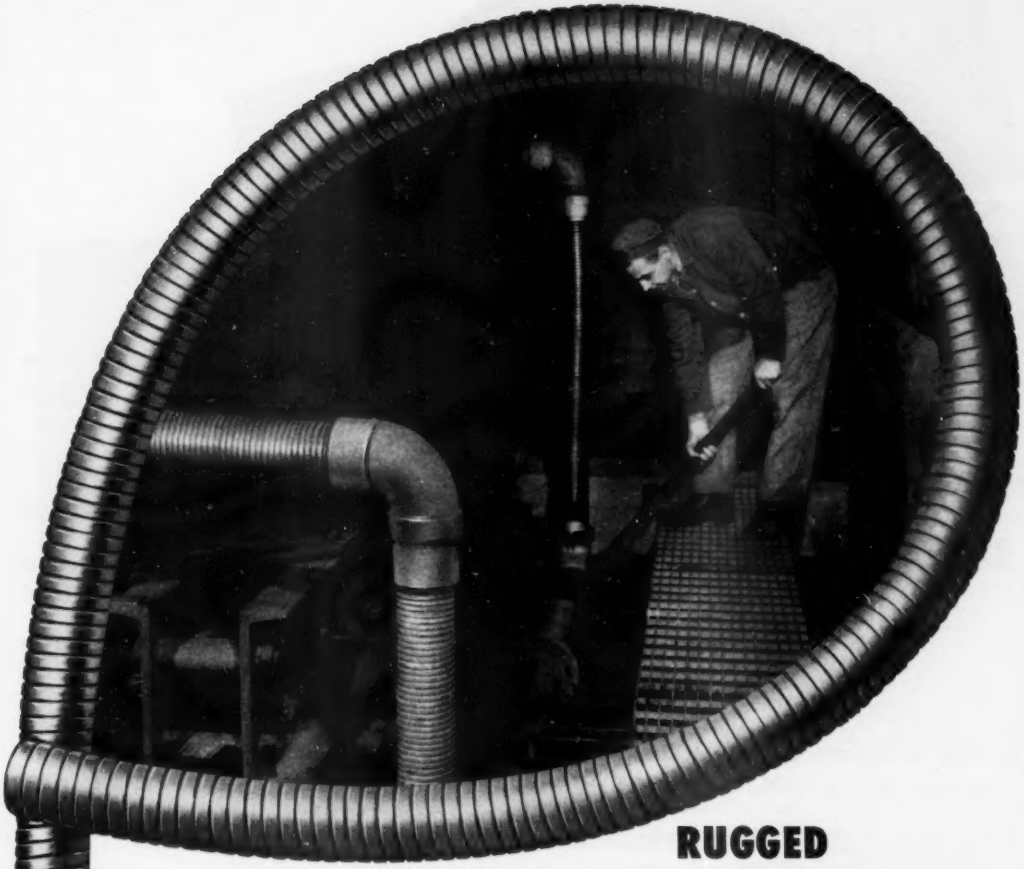
High Pressure Reducing Valve Type H-P; extra heavy for use with initial pressures up to 5000 lbs.; and for reduced pressures up to 650 lbs. Good for most fluids. Sizes: ⅜" to 2"; bronze body; nitralloy trim. Get Bulletin 931.



Type 8871 Pressure Regulator for dirty liquids (like Bunker C fuel oil). Inner valve is bolted to diaphragm for positive movement. Sizes ½" to 10". Bodies; iron, bronze, or steel. Seat ring and inner valve; stainless steel. Bulletin 972.



Cash Standard Type 10 Pressure Regulating Valve, pilot operated. (Pilot operating fluid discharges to outlet pipe; not wasted). Sizes: 2" to 12". Highest pressures: inlet 600 lbs.; reduced 250 lbs. Iron, bronze, or steel bodies; standard trims. For water, air, non-corrosive gases and oils. Get interesting Bulletin 966.



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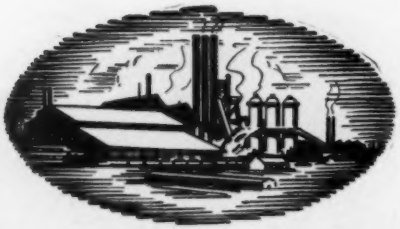

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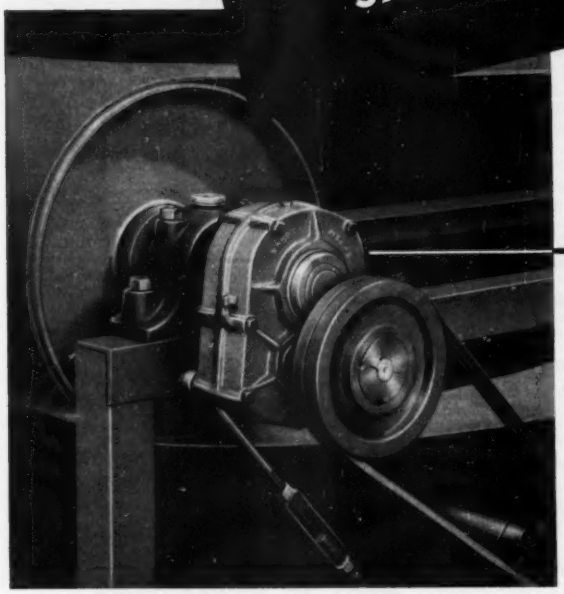

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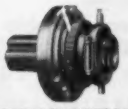

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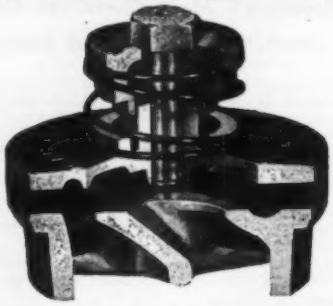

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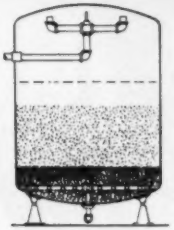
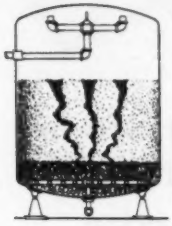
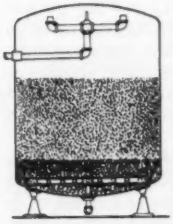
Is your water softener operating in the HIGH COST zone?



Check for zeolite loss



Check for packed and channelled zeolite



Check for worn out zeolite

Here's an easy way to find out

Far too many zeolite water softeners in use today are operating in the high cost zone—without it being known. How about your softener? Is it delivering less soft water than it did when new? Does it require more frequent regeneration with greater salt consumption? If so, it is operating in the high cost zone and you are not getting full value from your investment.

LOSS OF ZEOLITE can cause a big drop in soft water output.

PACKING AND CHANNELING will greatly reduce water softening capacity, cause hard water to leak through the softener and damage the zeolite.

WORN OUT OR DAMAGED ZEOLITE can also cause a big reduction in soft water gallonage.

Any of these troubles necessitate more frequent regeneration with greater salt consumption.

How to make your water softener perform like new

Any lost zeolite should be replaced with new at once. Damaged or worn out zeolite should be completely replaced. Packing and channeling can be remedied by loosening up the zeolite and providing the backwash rate required to properly cleanse and agitate the zeolite so that packing will not recur.

Your Elgin representative will be glad to check your softener and show you how to make it perform like new. With all types of zeolite to choose from, he can provide the kind you need. Whatever the type, you may be sure it will give maximum capacity and years of efficient service.

How to make it deliver up to 10 times more soft water

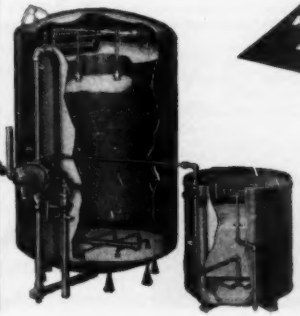
If your softener uses one of the older type zeolites of low softening capacity, you can switch to one of the amazing new Elgin high capacity types. In this way, it may be possible to get as much as 10 times more soft water from your softener. But even if the zeolite in your softener is entirely satisfactory, we can increase its capacity as much as 44% and prevent future costly zeolite loss. The ingenious Elgin Double Check type manifold, adaptable to any make of water softener, makes this possible. It permits the use of a deeper zeolite bed in your present softener which provides the added softening capacity as diagrammed below. Your Elgin representative can show you how this manifold arrangement can be installed at low cost in your water softener.

ELGIN SOFTENER CORPORATION, 130 N. Grove Avenue, Elgin, Illinois

Shallow zeolite bed of ordinary water softener gives limited softening capacity.

Deep zeolite bed, made possible by Elgin "Double Check" Manifold arrangement, gives up to 44% more softening capacity.

WRITE US TODAY for full particulars



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Economical
WATER CONDITIONING
FOR EVERY NEED
SINCE 1906

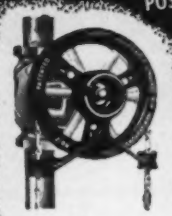
ELGIN WATER SOFTENER

Gives Up to 44% More Soft Water

Where new equipment is required, the advanced Elgin "Double Check" Water Softener is your best buy. Compared with others it delivers up to 44% more soft water; prevents costly zeolite loss; costs less to buy and operate. Ask for Bulletin 610.

POSITIVE! EFFICIENT! SAFER!

VALVE CONTROL AT LOWEST COST!



Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

INSTALLED, AND OPERATING, IN ONLY A FEW MINUTES

Range of 10 ADJUSTABLE sizes fits all valve wheels, with rising or non-rising stems, from 2 to 30 inches diameter.

●

Distributors in principal cities, or send for Catalog Folder F-2 and name of nearest distributor.

● Here's easy, convenient, instant control of overhead, out-of-reach valves — right from the floor. No expensive apparatus, no switches, nothing to break down when needed most! BABBITT Adjustable Sprocket Rim with Chain Guide is installed in a few minutes, and gives you positive, efficient valve control. Low initial cost is last cost! Prevents accidents, prevents waste, saves money!

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1 Babbitt Square, New Bedford, Massachusetts

FOR QUICK, EASY, DEPENDABLE TEMPERATURE SETTINGS... the New LESLIE Calibrated Dial is the Answer!!

The new *CALIBRATED DIAL* now available on Leslie Class T and Class M Temperature Regulators provides quick, easy and dependable temperature settings.

Features

★ **TIME SAVING** — *Just turn the dial to the desired setting—no waiting for equipment to heat up to find out if setting is correct.*

★ **SAFE** — *Avoids costly overheating caused by guess setting.*

★ **RUGGED** — *Designed for production line use where frequent dependable readjustments are necessary.*

★ **SIMPLE** — *Fits in place of standard adjusting sleeve. No complicated mechanism to go out of order.*

LESLIE Temperature Regulator Class MCC-1

SEND FOR — copy of Temperature Regulator Bulletin No. 464B

LESLIE CO. — ESTABLISHED 1900 — FIFTIETH ANNIVERSARY 1950

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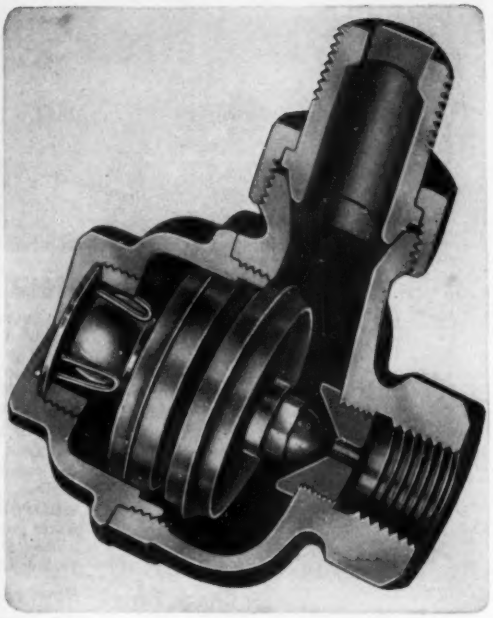
PRESSURE REDUCING VALVES • PRESSURE CONTROLLERS
FLOATLESS LEVEL CONTROLS • PUMP GOVERNORS
TEMPERATURE REGULATORS • SELF CLEANING STRAINERS
AIR HORNS • STEAM WHISTLES



Built for Long Life in Medium and High Pressure Service

For steam pressures between 15 and 100 pounds gage, your safest choice is a B & J Medium or High Pressure Thermostatic Trap. These traps are especially effective for use with coffee urns, sterilizers, general cooking apparatus, process fixtures and laundry equipment where pressures exceed 15 pounds.

Heavily constructed, B & J Medium and High Pressure Traps are designed particularly for such uses. Removable stainless steel seat and monel valve piece, the only parts that will ever wear out — thermostatic element and seat — can be replaced quickly and easily.

And remember, too: every single item produced by Barnes & Jones is thoroughly and exhaustively checked and must pass our most exacting requirements before it ever leaves our plant. Moral: you're *bound* to be *right* with Barnes & Jones.

B&J

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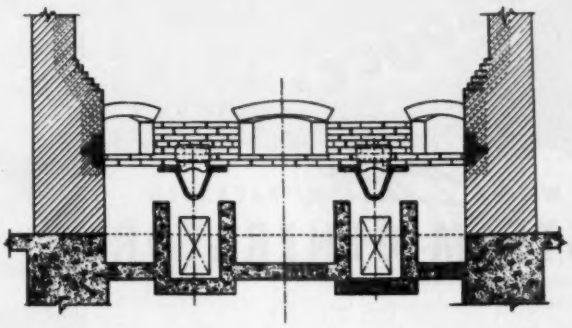
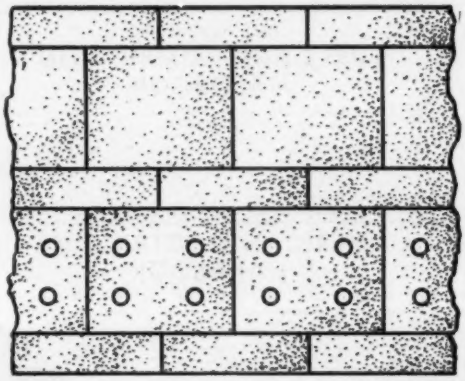
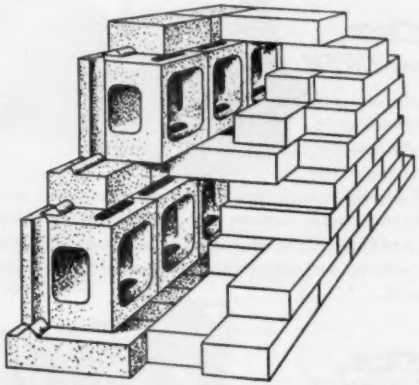
Cost Less to Maintain...



Solid Crystolon Brick Construction



Front View



Back View

Crystolon Air Cooled Block Construction

Because:

NORTON CRYSTOLON* BRICKS OR AIR COOLED BLOCKS at the clinker line, as detailed above, are: (1) so highly refractory that they successfully stand temperatures up to 2900°F; (2) so dense that they effectively resist slag penetration and clinker adhesion; (3) so hard that they are not noticeably affected by abrasion, even that caused by the moving fire bed of stoker-fired furnaces.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

WRITE FOR BULLETIN 862

For all the reasons why Norton Crystolon silicon carbide brick is your best buy for long service and low maintenance cost, consult your nearby Norton representative or write direct for Bulletin 862. Norton Company, 502 New Bond St. Worcester 6, Massachusetts.

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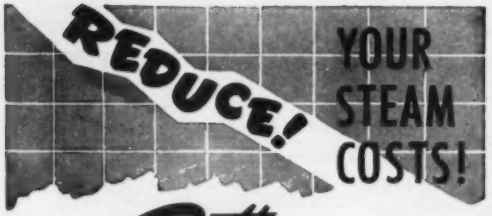
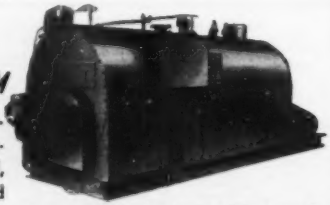


WITH A *Dutton* "PACKAGED"

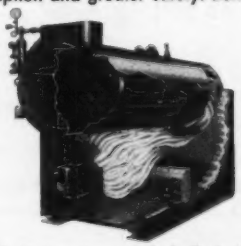
STEAM GENERATOR

Dutton Steam Generators are QUALITY PRODUCTS, incorporating exclusive features of LONG LIFE, LOW OPERATING AND MAINTENANCE COST, MAXIMUM EFFICIENCY and SAFETY that only 71 years experience in boiler making can produce. Dutton Automatic "Packaged" Steam Generators are completely assembled — no special foundation or expensive chimney are needed.



Dutton EconoTHERM

Completely self-contained, automatically operated, 3-pass modified Scotch Internal Furnace type which gives twice the power in half the usual space. Features such as the Dutton Off-Center Firing and Rotary Combustion assure faster steam and more steam with less fuel consumption and greater safety. Burns gas or oil.



Dutton EconoMIST

A highly efficient horizontal return tube type, assembled in portable casing and ready for firing on arrival. Dutton improved shell design and double size full length, high bricked firebox, give faster steaming and longer steam carry-over with less fuel consumption. Burns oil, gas or coal with high efficiency — easily converted from one fuel to another. Available as a package unit with firing equipment, controls and mechanical draft with short stack.

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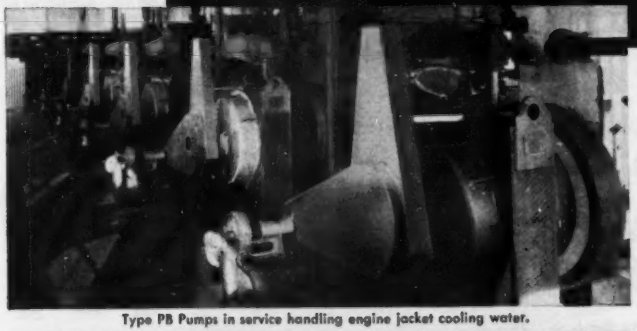
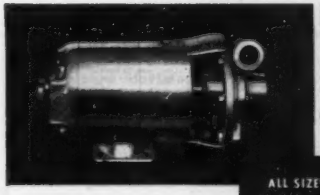
BIG OR SMALL — INDOORS OR OUT YOU CAN SAVE ON COST AND SERVICE WITH PEERLESS *FLUIDYNE* PUMPS

PEERLESS PUMPS



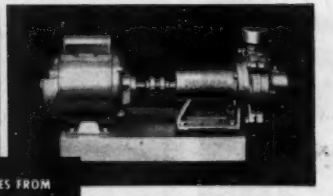
Type PB Pumps in service handling engine jacket cooling water.

Type PB Pumps providing water supply to pressure system.

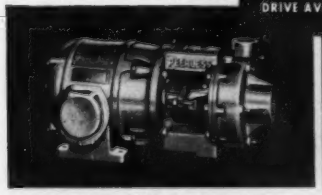


Fractional HP Close Coupled Electric Type PE Fluidyne Pump

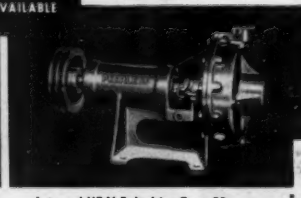
ALL SIZES FROM ¼ H. P. to 150 H. P. ALL TYPES OF DRIVE AVAILABLE



Fractional HP Flexible Coupled Type PB Fluidyne Pump



Integral HP Close Coupled Electric Type PE Fluidyne Pump



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3. **They're EFFICIENT.** In all sizes, types and models the Fluidyne line is characterized by high performance ratings.
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9. **They're HYDRAULICALLY CORRECT.** Peerless impeller and volute design assure nonpulsating, non-turbulent liquid flow.
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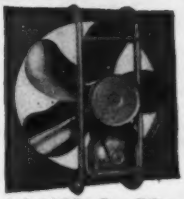

Industrial Fan Type IND— For large general area ventilation. Moves large volumes of air under pressure. Sizes from 24" to 60".

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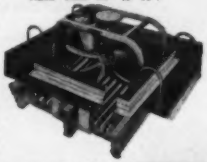

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Build STAMINA into your pipe-lines

Reduce maintenance with D-F S-E* *Joints*

Shortages of manpower require you to build stamina in your lines. **Directed-Flexing Self-Equalizing*, an exclusive feature of Badger Expansion joints, assures all-curve flexing in the corrugated member. Thus, localized flexing stresses cannot form . . . metal fatigue cut to a minimum . . . breakdowns are virtually eliminated.

But that's not the whole Badger story. In addition to controlling the flexing movement *within* each corrugation, the specially designed Self-Equalizing Rings also control intra-corrugation movement. For unbeatable stamina be sure you get the exclusive Badger combination — Directed-Flexing Self-Equalizing — when you buy . . . specify Badger Expansion joints for every job.

Only Badger Expansion Joints have Directed-Flexing Self-Equalizing rings which progressively control the movement of the all-curve corrugations.

Plus 5 other big features

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- **Compact . . . approximately the size of flanged fitting**
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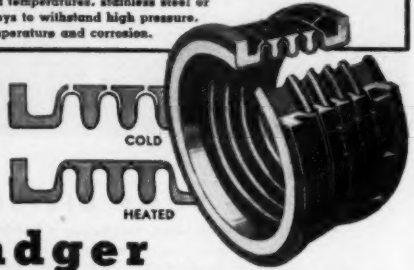
- **Wide range of traverse — pressure — temperature**

Fabricated from deoxidized copper for normal pressures and temperatures, stainless steel or alloys to withstand high pressure, temperature and corrosion.



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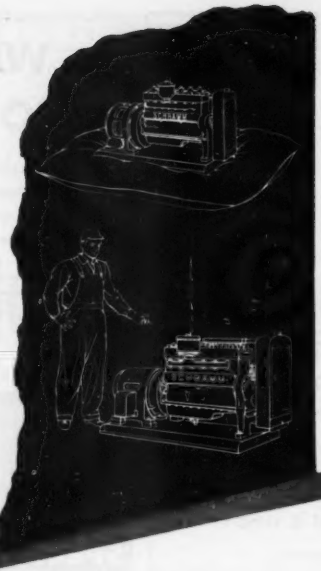
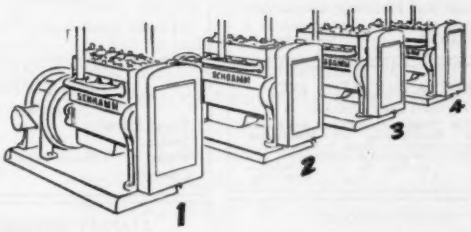
Compact



SCHRAMM
"UNIT SYSTEM"



One cost—
no elaborate
foundation

Easy to move

Complete
package—
easy to install

Installing Schramm Air Compressors as a "unit system" in your plant offers definite savings.

With ease, and without elaborate foundations (two savings in installation alone) you can install several Schramm Air Compressors . . . as your air needs require . . . in a minimum of space . . . for less money than one large compressor. This set-up offers such advantages as:

1. Elimination of costly pipe lines to every corner of your plant.
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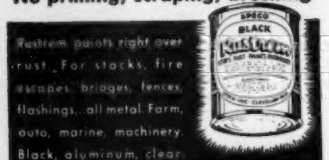
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supplements other advertising in this issue with these additional announcements of products and services essential to modern plant management and Maintenance. Make a habit of checking this page, each issue.
Classified Advertising Division
POWER

The Defense Production Problem

To win out in the struggle for freedom into which the Russian Communists have plunged us we must do at least four things. We must:

1. Speedily carry through a program of defense production which, at its peak, is scheduled to take about one-fifth of our national output.

2. Pay for this program as we go, by methods that will enable us to maintain the effort for an indefinite period – as long as may be necessary to insure peace and security.

3. Manage intelligently and endure intelligently a set of direct government controls which, in certain critical departments, will put our national economy for a time in a hateful straight jacket.

4. See that these emergency controls are not fastened upon us permanently thereby presenting to our Soviet antagonists a major victory for collectivism on our home front.

This is the first of a series of editorials designed to present in the simplest terms these key aspects of our struggle to preserve our free institutions.

A Staggering Task

The magnitude of the defense production job staggers the imagination. Over the next year it calls for a larger volume of goods and services than the 20 million people of the states of New York and New Jersey will use for all purposes. The (London) TIMES has observed that, taken alone, the increase of defense expenditures which has been budgeted for the federal government's coming fiscal year (about $30 billion) "is in itself not far short of the total national income of the United Kingdom."

Yet so powerful is the production machine created by free American enterprise that, at the scheduled peak, the defense program will take only about one-fifth of our total national output. The exact form and dimensions of the program will, of course, be hammered out on the anvil of public and congressional debate. But the President's recent estimate of an annual rate of expenditure of $45-55 billion for defense by the end of this year may well turn out to be somewhere near right.

To meet even these vast requirements of defense production we are in better shape technically than we were when we started to prepare for World War II. Our industrial plant and equipment is greatly improved. Over $65 billion has been invested in it since V-J Day. Our working force is about eight million larger than it was ten years ago and much better trained.

The difficulty, and it is a very serious economic difficulty, is that we must fit the defense program into a productive machine that has been almost fully extended to meet the needs of a booming civilian demand. The present plan is to step up defense production during 1951 from about 7% to about 18% of our total national output. Because there is relatively little slack in our economy, this means that civilian production at the outset must

be cut back as defense production is stepped up

The cut-back of civilian goods must be especially severe in the case of products made of metal. This is particularly true of goods that use scarce strategic metals such as aluminum and copper. Of our total defense production program, about half will go for "military hardware" – airplanes, guns, munitions, tanks and the machinery to make them. By the end of 1951 defense requirements are scheduled to absorb most of the metalworking production not required for essential construction and for the spare parts necessary to keep existing equipment running. For a time at least, there will be a sharp cut in the supply of new metal products available to civilian consumers. The defense squeeze on both materials and manpower will also cut sharply into housing and other civilian construction.

For the Short Run — Controls

In the short run there is no answer to the problem of meeting defense production schedules except controls. Sharp reduction of non-defense expenditures by government is essential and would help greatly. But the basic fact is that we cannot increase our total production fast enough to meet immediately both civilian and defense requirements.

Controls are needed, therefore, to switch resources from civilian to defense production, and at the same time prevent the combined demand for critical products from sending prices right through the roof. In the case of many scarce strategic metals such as nickel, copper and cobalt, the task of increasing output is especially difficult because our limited supplies are tucked away deep in the earth in many quarters of the globe.

For the longer pull – and that is what we must face – there is another answer to our defense production problem that is infinitely better than controls. And this time, in contrast to World War II, it is all-important that we get the right answer to our defense production problem for the longer pull and that we get it right now. In World War II we geared our economy to meet the requirements of a relatively short and decisive conflict. Now our leaders, however they may differ as to methods, are well agreed that, at best, "the conditions under which we labor may persist for ten, fifteen or twenty years." That is General Bradley's phrase.

For the Long Pull — More and Better Production

For this longer pull, the constructive answer to our problem of defense production is clearly more and more efficient production all along the line. It is true that overall we now have the most efficient industrial establishment in the world. But, even so, much of it is far short of attainable efficiency. Some plants using up-to-date equipment and methods are as much as six times more efficient than others in the same industry that are lagging in modernization.

Our Director of Mobilization, Charles E. Wilson, has clearly in mind this problem of increasing our industrial efficiency. The first step in his job, as he conceives it, is to get out an adequate supply of weapons to equip the army, navy, and air forces already mobilized or in process of organization by us and our allies. The second step is to make sure of our capacity to produce both "military hardware" to meet any increased requirements and the maximum possible volume of goods for civilian use.

In concentrating on more and more efficient production, Mr. Wilson is squarely on the beam. We can attain his objective – by sustained effort on the part of each one of us backed by up-to-date industrial methods and equipment.

If we do that, we can maintain indefinitely an adequate defense effort and at the same time enjoy a standard of living higher than any other in the world.

Additional production and more efficient production are our surest safeguards against our two most menacing enemies on the home front – the deadly inflation that can destroy our free economy, and the strangling government controls that can destroy our political freedom.

McGraw-Hill Publishing Company, Inc.

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POWER PLANT Operator, age 29 with eight yrs. experience in modern power plant operation and maintenance, also some refrigeration. Technical school graduate. PW-8515, Power.

WAR VET, age 30, wants job as apprentice Power Engineer; some experience at several maintenance trades; B.S. degree in Industrial Arts. Write or wire Box 53, Hamburg, Ark.

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MANUFACTURERS' AGENT and Sales Engineer, now employed, desires connections with manufacturer as Sales Representative or with established agency in New York State, Penna., or Conn. territory. 15 years sales experience, heating, ventilating, refrigeration and AC equipment. Graduate engineer. Answers should briefly outline proposition. Reply RA-9307, Power.

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Now we are expanding our activities in the boiler manufacturing field and must increase our engineering and drafting force. We need boiler draftsmen and designers for permanent employment—experienced in heavy and light plate work, structural steel, pressure vessels, piping and similar work.

Our employer-employee relations are excellent. People live peacefully here in the center of the prairie state and are friendly and neighborly.

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300-500 Kva., 550/3/60 diesel generator set. Please quote on unit and on engine and generator separately.
AIR COMPRESSOR: 750-1000 C.F.M., 100-lbs. with or without 440/3/60 motor.
75-100 H.P. Squirrel cage motor, 440/3/60, 300 or 400 RPM.
100-H.P., 440/3/60 Slip Ring motor, 1200 RPM. Explosion proof with explosion proof control.
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2—Diesel Generator sets 150 or 175 KVA each 3 phase 60 cycle 440 volts preferred

500 tons mine rails 12-16-20 lb.—20 lb. preferred

150 H.P. 550/3/60 slip ring motor with controller and resistance

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FOR SALE: 2—300 - H.P. 2300/3/60/3600 - RPM squirrel cage motors with special insulation for high temperature, scarcely used.

Please send your surplus list of electric and power machinery.

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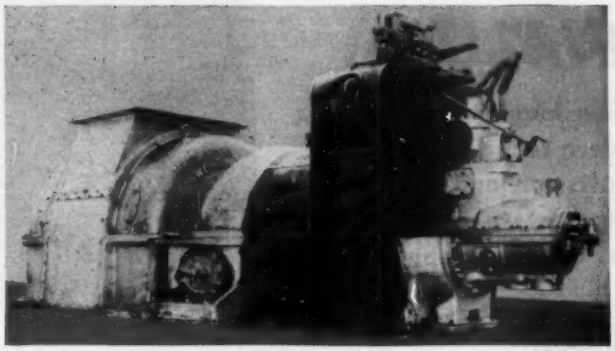

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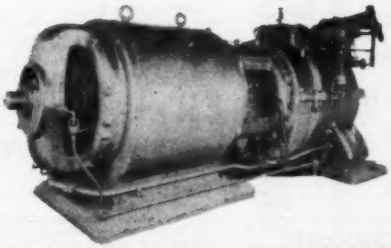
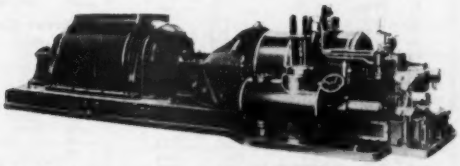


A 750-KW., G.E., Condensing, Aut. Extr., 90% of Throttle Flow at 15#, 215# psig., 3/60/2300-v., 937-KVA., 3600-RPM. Condition, Pass any Inspection. Complete Unit, Condenser, Switchboard, Exciter. INVESTIGATE NOW. Turbine Serial 28304: Generator, 3868840. Also 2-750, 480-Volt, Same as Above in Stock. Bulletin 975 with Specs., Illustrated Is Free.



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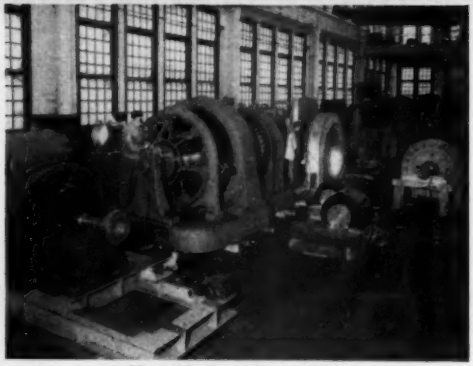

Views of Portions of Electrical Shop

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3 PHASE — 60 CYCLE

Q.	HP	Make	Type	Volts	Speed
1	1250	G.E.	Syn.	440	1200
1	1200	Cr. Wh.	Sl. Rg.	2300	257
1	600	West.	CS	2200	900
2	600	West.	Syn.	440	257
1	400	West.	CW	440	514
1	350	West.	CW	440	600
1	315	G.E.	Syn.	2200	720
1	250	West.	CS	2200 (25 cyc)	375
1	250	West.	CS	2300	1200
2	200	E.M.	Syn.	4160	600
1	200	West.	MW	440	600
1	150	Ideal	Syn.	220	1200
1	150	El. Meh.	Syn.	220	900
1	125	Cent.	SC	440	1800
2	100	West.	CS	220	1800
1	100	Cent.	SC	220	1200
1	100	C.W.	SC	200	900
1	100	A.C.	Sl. Rg.	440	720
2	100	G.E.	Syn.	440	300
1	75	Wagner	BM	440	900
1	75	West.	CW	440	1200
1	60	Ideal	SC	220	1200
1	60	West.	C.W.	440	720
3	50	A.C.	SC	220	900
1	50	West.	CS	400	3600
1	50	West.	C.W.	220	900
1	50	G.E.	I.M.	440	600
2	50	Cent.	SC	220	1200
1	40	G.E.	MT-536	440	900
1	30	G.E.	MT-532	440	900
2	25	G.E.	MT-332	440	900

Direct Current — 230 Volt

2	1½	West.	B	230	1750
2	1½	G.E.	BD	230	1750
1	2	G.E.	RC24B	230	1700
2	2	West.	CD	230	1150
1	2	A.L.	AW5C	230	900
1	3	Diehl	S	230	850
1	3	West.	SK	230	1150
2	5	West.	S	230 (Crane Motor)	550
1	5	G.E.	RC	230	1100
1	7½	G.E.	RC	230	850
1	7½	West.	SK43	230	1150
1	7½	A.C.	E75	230	1150
1	7½	G.E.	BD	230	3450
1	10	G.E.	CD	230	1250
1	15	Cr. Wh.	CCM	230	850
12	15	G.E.	RF	250	300/1500
1	15	G.E.	RC	230	1150
1	20	West.	SK	230	1100
1	20	G.E.	RC	230	800
1	25	West.	SK	230	900
1	25	El. Dyn.	S	230	800
1	25	G.E.	RC	230	3450
1	75	West.	SK	230	800
1	250	Cr. Wh.	DR	230	1900

Direct Current — 230 Volts
Variable Speed

1	5	El. Dyn.	SH	230	550/1650
1	5	Diehl	SH	230	670/1200
1	5	G.E.	RLC	230	480/1605
1	7½	G.E.	R.E.	230	450/1350
1	10	G.E.	RF-10	220	400/1200
1	10	G.E.	RLC	230	500/1200
1	10	G.E.	RF	230	525/1525
1	10	Ele. Dyn.	S	230	425/1275
1	15	Burke	AM7	230	300/1200
1	15/20	Ele. Dyn.	15-S	230	300/900
1	20	Ele. Dyn.	S	230	550/1650
1	25	Cr. Wh.	CMC	230	850/1725
1	25	C & C	L	230	250/1000
1	40	West.	SK	230	500/1500
1	50	Cr. Wh.	CMC	230	300/1200
1	50	G.E.	RF-16	230	300/1200
1	100	G.E.	RF-17	230	450/900
1	105	Century	R	70	1160

Direct Current — 115 Volts

1	1	West.	SK	115	1750
1	1½	G.E.	CVC	115	550
1	3	G.E.	CD-45	115	1150
1	3	G.E.	RC	115	1700
12	10	G.E.	CDM NEW	115	1750
1	10	Cr. Wh.	CM	115	825
1	12½	Ideal	D	125	700
1	40	Ideal	D	125	1750
1	75	Cr. Wh.	CMC	115	410
1	85	G.E.	RC	115	1100

MOTOR GENERATORS

1—1000 KW G.E. MPC ATI 550 Volt, 3 phase, 60 cycle, 2300 volt
1—400 KW West. 3 unit set, 250 volt D.C. 3/60/440 A.C. Syn.
1—300 KW West. 250 V—3/60/2300/1200 rpm
1—100 KW G.E. 125 V—3/60/220/1200 rpm Syn.
1— 80 KW G.E. 240 V—3/60/440/1800 rpm

500 KW Crocker Wheeler Type CCD, 230 volt D.C. 720 rpm, Generator on Baseplate with 750 KVA Crocker Wheeler 3/60/2300 syn. motor, complete with Syn. Motor Starting Panel, Generator panel.

1— 50 KW G.E. 250 V—3/60/240/1200 rpm
1— 50 KW G.E. 125 V—3/60/220/1200 rpm
1— 40 KW Ideal 125 V—3/60/220/1200 rpm
1— 40 KW West. 240 V—3/60/220-440/1200 rpm Syn.
1— 7½ KW G.E. 125 V—3/60/220-240 v

DIESEL GENERATORS

1—2500 KVA General Motors, complete plant, 3/60/2300 with 2300 to 230/460 transformers, cooling system, starting equipment, switchboard, can demonstrate on foundations. Immediately available.
1—225 KVA G.M. Twin 6-71, 3/60/440. NEW 1941
200 KW Fairbanks Morse, 250v., D.C. 720 rpm 8 cylinder, 4 cycle, Complete—1940
200 KW G.E.-Fairbanks Morse, 720 rpm, 3/60/220/440—8 cyl., 4 cycle—1940
200 KVA Cummins LI 400 3/60/440/900 rpm—Radiator—Sw. Bd.
100 KVA Cooper Bessemer 8 cy 900 rpm, 3/60/220
56 KVA G.E.-Climax Gas Port, 3/60/220/1200 rpm
1—50 KW G.E. 250 V .D.C. Gen with Cummins Mod HMR—6 cyl, 4 cy, 1200 rpm diesel
40 KVA NEW Chrysler 3/60/220—2 units
30 KW Buda, 3/60/220/1200 rpm
20 KW Le Roi Gasoline—1/60/110-220 volt

TURBO-GENERATORS

1—780 KVA West. 2400 volt, 3/60/3600 rpm, 200 psi. Condensing
1—625 KW West. 3/60/2300/3600 rpm, 125 Lb. psi, 6 Lb. B.P.
1—600 KW G.E. Extraction 360/2300/250 psi., 80 lb. & 16 lb. extraction. Surface Condenser new 1940
1—400 KW West. 3/60/480, 150 psi., 10 Lb. B.P.
1—300 KW G.E. 2300 volt, 3/60/3600 rpm—Curtis—4 stage turbine 200#—Condensing
1—300 KW Elliott (new 1941) 250 Volt D.C., 150 Lb. I.S.P., 20 Lb. B.P.
1—300 KW G.E. 3/60/2300/100 p.s.i. 0-15 Lb. B.P.
1—160 KW West. 3/60/220/3600 rpm, 125 Lb. psi., 10 Lb. B.P.
1—160 KW Ridgeway 4 Valve Steam Engine Generator, 3/60/220
1—100 KW NEW 3/60/220 150/200 psi. 0/30 Lb. B.P.
1—75 KW G.E. 125 V. D.C. Non-Cond. 150#
1—35 KW G.E. 125 volt D.C., 3600 rpm

PHILADELPHIA'S LARGEST MACHINERY DEALERS AND EXPORTERS

TELEPHONE
GArfield 6-1150
•
CABLE ADDRESS
OBRIEN-PHILA

THE O'BRIEN

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ALL YOUR MACHINERY NEEDS

Showing Facilities for Rebuilding All Types of Equipment

INTEGRITY

For 37 years The O'Brien Machinery Company has faithfully upheld the highest standards of business practice while serving our country's industry.

A.C. GENERATORS

KVA	Make	Phase	Cycles	Volts	Speed
1250	West.	3	60	440	1200
500	West.	3	60	440	900
2—500	West.	3	60	440	257
375	West.	3	60	440	360
300	G.E.	3	60	2200	720
300	G.E.	3	100	550	600
200	Al. Ch.	3	60	220	900
125	E.M. (NEW)	3	60	220	900
100	G.E.	2	60	220	900
100	Ideal	2	60	220	1200
62.5	Burke	3	60	220	1200
32.5	G.E.	3	60	220	1200
15	Ideal	2	60	220	1800
15— 7.5	G.E. (NEW)	1	60	120	1800

TURBO BLOWER SPECIAL

3—Ingersoll Rand Type CVS—20" New 1941-42 12,000 cfm, 3.25#, 3550 rpm—direct connected to 250 HP G.E. 3/60/440/3600 rpm motors. 2 units cast iron—1 fabricated steel.

STEAM ENGINES

1—400 HP Ames Vertical Uniflow 4 cyl. 12 x 12—360 rpm
60—30 HP NEW Troy Vertical Steam Engines 7 x 6, 150 Lb. 500 rpm Throttling Governor

PUMPS

1—20" Lea Courtney, 20,000 gpm, 200 ft. Turbine Drive 175/250 PSI condensing
1—20" Lea Courtney, 10500 gpm, 100 ft. 400 HP, 3/60/970 rpm
1—20" De Laval—Double Suction, 10,500 gpm, 114 ft. 400 HP, 3/60/870 rpm
1—16" Lea Courtney, 17,000 gpm, 200 ft. Turbine Drive—175/260 psi condensing
1—16" Lea Courtney double suction, 8150 gpm, 102 ft. 250 HP 3/60/1200 rpm
1—14" Worthington Double Suction 5000 gpm, 112 ft. 200 HP 3/60/440/900 rpm
1—14" Worthington Double Suction, 6800 gpm, 200 ft. 3/60/440/1150 rpm
1—10" Wheeler, 3500 gpm, 80 ft. with 100 HP, 3/60/440/1750 rpm motor
2— 8" De Laval Double suction, 2500 gpm, 200 ft. with 200 HP 3/60/2300/1750 rpm motor
1— 8" De Laval Dble Suction, 1500 gpm, 231 ft. TNH. with 150 HP, 3/60/440/1750 rpm
3— 6" Worthington Dble Suction, 1200 gpm, 40 ft. TNH. with 15 HP, 3/60/440/1750 rpm
2— 2" Worthington NEW 2UB1 Double Suction with 10 HP, 3/60/220/1750 rpm motor

BOILERS

1—200 HP Keeler Horizontal Long Drum Water Tube 160 Lb. used very little
1—352 HP Keeler Water Tube ASME Mechanical Stoker—200 Lb.
1—540 HP Keeler Water Tube 250 Lb. ASME Steel encased Riley Pulverizer and oil burner equipment—with side water walls
1— 25 HP McKee Gas Fired 100# Dowthern Vapor Generator

SWITCHBOARDS— CONTROL PANELS AC/DC

We Will Build to Your Specifications—Any and All Types of Control Panels—Wire or Write Your Specifications.

TRANSFORMERS

Qs.	KVA	Make	Type	Phase	Pri.	Sec.
19	1½	G.E.	OISC	1	3400/4160	120/240
1	5	West.	OISC	1	2300	230/115
1	10	Pittsburgh	OISC	1	220	110/220
2	25	Bisler NEW	Air	1	440/220	220/110
1	35	West.	Air	1	220/110	220/110
1	50	G.E.	OISC	1	12,000	240/480
1	75	West.	OISC	3	440	220
2	100	West.	OISC	1	2300	230/115
1	100	Red Line	OISC	1	2300	230/460
3	150	West. NEW	OISC	3	6900	208/120
1	150	West.	OISC	1	2400	240/120
4	300	G.E.	OISC	1	2280/3810	220/110

COMPLETE POWER PLANT

consisting of

1—750 KVA General Electric Extraction Turbo Generator, 3/60/2300 volt, 250 psi, 80 pound and 16 pound extraction. Surface condenser, switchboard. New 1940.
1—390 HP and 2—360 HP Springfield Sectional Header 300 psi, water tube boilers, with superheaters, side water wall construction, including Combustion Type E Stokers. Green Fuel economizer, Feedwater heaters, Coal unloading and conveying equipment, Boiler feed pumps, etc.

Now in operation, available April 1st, 1951.

AIR COMPRESSORS

3—12,000 CFM Ingersoll Rand Turbo Comp. 3.25# pressure, 250 HP 3/60/440/3600 rpm md
1—3000 CFM Sullivan Angle Compound 100 psi, 500 HP Syn. M.D. 3/60/2300

1690 CFM Sullivan 100" Class WN 2, 12 x 12½ x 16 Two Stage Syn. motor 250 HP 3/60/2300 volt. Exciter, Starting Equipment—Can be Inspected Operating.

1—1050 CFM Worthington, 18x11x14 100 psi, 257 RPM, Belted
1—1050 CFM Ingersoll-Rand ES-1, 17⅝x13, 50 psi, 275 RPM, V-belt
1—734 CFM Sullivan Angle Class W13, Single Stage 13x13x8, 60 Lb., 300 RPM, v-belt, 100 HP
2—528 CFM Chicago NSB, 100 Lb., 285 RPM, V-belt, 14x12
2—368 CFM Ingersoll ER-1, 285 RPM, 100 psi., 50 HP direct gear, M.D., 3/60/220
1—277 CFM Chicago PB4 Air Cooled 50 HP V-Belt Motor Drive
1—245 CFM IR-10x10 ER-1, 125 Lb.
1—215 CFM Penna. 3A—10x8, 50 Lb.
2—173 CFM Ingersoll ER-1, 9x8, 300 RPM, 100 Lb., V-belt

Priced for Removal April 1st

1—880 CFM Worthington—17 x 10½ x 12—100# W.P. Syn. Motor-driven—150 HP E.M. 3/60/440 volt—with exciter. Starting Panel. Can be inspected operating at Reading, Pa.

BLOWERS

3—Industrial Engineering Co. 5000 CFM, 3", high temperature blowers with 5 HP 3/60/220/1800 rpm motors—800° F.
20—American New Vent Blowers—3000 CFM—¾" S.P.—V-belt drive
1—G.E. Turbo-Blower 3810 CFM—9 psi. direct connected to 95 HP, 3/60/440/3600 rpm motor
1—Spencer—950 CFM, 16 oz. Turbo with 7½ HP 3/60/220-440/3600 rpm motor
11—NEW #50 O'Brien Red Line, belt driven
5—NEW #45 O'Brien Red Line, belt driven
32—NEW #30 O'Brien Red Line, belt driven
2—NEW #25 O'Brien Red Line, belt driven
2—NEW #15 O'Brien Red Line, belt driven

. . . "EVERYTHING FROM A PULLEY TO A POWERHOUSE" . . .

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THE HOME OF VALUE AND QUALITY FOR . . .

ELECTRICAL POWER EQUIPMENT

GET A-1 PERFORMANCE
SAVE ON PRICE

HERE'S A WIDE SELECTION FROM OUR GIANT STOCK

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

H.P.	Make	Type	Speed
1000	*G.E.	K6327B	1800
700	*G.E.	KT	720
500	*G.E.	PBG	1200
500	*Fr-Morse	HS	1200
500	*Cent (New)	NZ	1800
400	*Al-Ch.	ARWW	900
300	*Westgh.	CS	3600
300	G.E.	FT-559	1800
300	G.E.	IE	1200
300	Al-Ch.	AR	900
300	Westgh.	CS	514
250	Westgh.	CS	1800
250	L-Allis	1408	720
250	Westgh.	CS	600
200	Al-Ch. (TEFC)	ARZ	1800
200	G.E.	IE	1800
150	*Al-Ch.	AW	1800
150	G.E.	IE	1200
150	Westgh. (New)	CS9550A	3600
125	Westgh. (New)	CS504	3600
125	*Al-Ch.	AR220	1800
125	G.E. TEFC	K6320G	1200
120	G.E. (New)	(6333	900
100	*G.E.	FT342Z	1800
100	Westgh.	CS	1800
100	U.S. (Vert)	CFU	1200
100	Burke	EM	1200
100	Westgh.	CS	1200
100	Century (New)	CS	900
100	G.E. (New)	K6333	720
75	Westgh.	CS761	1800
75	Westgh. (New)	CS3859	1800
75	G.E.	K586	1200
75	G.E.	KT346	1200
75	*Westgh. (Vert)	CS	900
75	G.E.	6333	720
75	Ideal	AA330	720
75	*G.E.	IK	720
75	Al-Ch.	AN	720
60	G.E. (New)	K4445	1800
60	Westgh. (Vert)	CSW445	1800
60	G.E. (New)	K504U	1200
60	Al-Ch. (New)	AR8230	900
60	Al-Ch.	AR826F	514
50	G.E.	KT327	1800
50	U.S. (Vert)	SCW	1800
50	Westgh.	CS840	1800
50	Westgh.	CS574	1200
50	G.E.	KT343	1200
50	*G.E.	KT342	900

Hundreds of Smaller Motors!

SLIP RING MOTORS

3 Phase, 60 Cycle, 220 or 440 volts (*2200 volts or higher)

H.P.	Make	Type	Speed
2000	*G.E.	MT30	240
1200	*Cr-Wh.		240
650	Westgh.	HE	358
500	Westgh.	CW	358
300	*G.E.	IM	1800
300	G.E.	MT	450
200	G.E.	IM	1800
200	G.E.	IM	900
150	Westgh. (New)	CS772C	1200
125	G.E. (New)	M6333	900
125	G.E. (New)	M6334	720
100	G.E.	MT	1800
100	A.C.	ANY	900
100	G.E.	IM	720
100	Westgh.	CW	600
100	G.E.	IM	450
75	Star	0900	900
60	G.E. (New)	M565	1200
60	Westgh.	CW	900
50	G.E.	IM	1800
50	Al-Ch.	ARY	1800
50	Westgh.	CW	1200
50	G.E.	IM	425
40	G.E.	MT336	1200
40	Westgh.	CW-644	900
40	G.E. (New)	M504U	900
40	Al-Ch.	ARY223	720
35	Fr-Morse	UAB	1800
35	G.E.	IM	1200
30	Westgh.	CW	1800
30	G.E.	MT332	1200
30	G.E.	IM	1200
25	Al-Ch.	ARY-220	900
20	Al-Ch.	ARY-216	1200
20	G.E.	MT312	1200
20	G.E.	MT522	900
20	G.E.	IM	720
20	Westgh.	CW-844	600
15	L-Allis	GN526	1800
15	G.E.	IM	1200
15	Al-Ch.	ARY218	900

SLIP RING MOTORS

Crane and Hoist Type 3/60/220 or 440 volt

HP	Make	Type	Speed
75	Westgh.	C1758A	900
37	G.E.	MITC TENV	900
30	G.E.	ITC5010	1200
25	Westgh.	C1572	900
20	G.E.	ITC5010	720
11	Westgh.	C1464	900
6½	Fr-Morse	425A TENV	1200
5	G.E.	MTC5180	1200
3	G.E.	MR254 TENV	1200
3	G.E.	MTC5100	1200
2½	G.E.	MTC5138	1200
2½	Star	AB827	1200

TURBINE SPECIAL

312 KVA Crocker - Wheeler AC Generator, 3/60/240/480 volt, d/c to

375 HP Worthington - Moore Turbine, Single Automatic, Non-Condensing, 425# PSI, 10# Exh., 100° F SH with Reduction Gear and Accessories

AC SYNCHRONOUS MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

H.P.	Make	Type	P.F.	Speed
750	*Westgh.		.8	900
450	El. Machy.	Ped.	1.0	240
320	*Al-Ch.	Dr Pf Eng.	1.0	720
300	Cr-Wh	Eng.	1.0	300
250	*Al-Ch	Dr Pf	.8	720
150	El. Machy.	EM	.8	720
125	El. Machy.	Sys	1.0	900
125	Cr-Wh	103-S	1.0	900
100	El. Machy.	Ped	1.0	450
100	G.E.	TSG545	.8	1200
100	Cr-Wh	103S	.8	900
100	*G.E.	ATS	.8	900
100	Ideal	SMS	1.0	900
75	G.E.	ATI	1.0	900
60	G.E.	TS7538	1.0	1200
50	Fynn W.	15VRN		1200
15	Century	ARC365	1.0	1200
4	G.E.	AK (25 cy)		1500

AC SYNCHRONOUS GENERATORS

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

KVA	Make	Type	P.F.	Speed
1065	G.E.	ATI	.8	900
1000	*Westgh.	SO3D	.8	900
250	*Al-Ch (New)		.8	720
150	El. Machy.	EM	.8	720
112.5	*G.E.	ATB	.8	1200
112.5	G.E.	TS	.8	1200
110	Cr.-Wh.	103	.8	900
100	*G.E.	ATB	.8	900
60	Fr.-Morse	B	.8	900
55	G.E.	ATB	.8	1200
50	G.E.	ATB	.8	1200
50	Westgh.		.8	1200
50	Cr.-Wh.	3056	.8	1200
37.5	Al-Ch.	EA121	.8	1800

TRANSFORMERS

3—2000 KVA Maloney, 1 phase, 13,200 v. 2primary, 2300/4160 v. secondary

1— 750 KVA Westg.—AIR, 3 ph., 12,000 v. primary, 480 v. secondary

3—750 KVA Westg.—AIR 3 ph., 13,800 v. primary, 2,300 v. secondary

3—300 KVA Gen. Elec., 3 ph., 13,800 v. primary, 240/480 v. secondary

3—300 KVA Gen Elec., 3 ph., 2400 v. primary, 240/480 v. secondary

3—250 KVA Allis-Chalmers, 1 ph., 34,500 v. primary, 240/480 v. secondary

9—250 KVA Gen. Elec., 1 ph., 2400/4160 v. primary, 240/480 v. secondary

3—150 Gen. Elec., 1 ph., 33,000 v. primary, 240/480 v. secondary

MOTOR GENERATOR SETS

K.W.	Make	A.C.	D.C.
550	Westg.-G.E.	2300	125
500	Westg.	2300	250
500	Westg.	550	250
500	Cr-Wh.	220/440	250
450	G.E.	2300	250
450	Westg.	2300	600
350	Westg.-G.E.	440	250
200	G.E.	440	250
150	G.E.	2300/440	250
150	G.E.	440	250/275
150	Cr-Wh.	440	250
150	Al-Ch	220	125
100	G.E.	440	250
100	G.E.	220	250
75	Al-Ch	440	250
75	Westg.	2550	110
60	Al-Ch	2550	110
40	Cr-Wh	220	125
40	Al-Ch	440	250
30	Cr-Wh	220	125
25	G.E.	440	250
20	G.E.	440	250
20	G.E.	440	125
10	Cr-Wh	220	125
10	G.E.	440	250
D.C. to A.C.			
100	G.E.	230	250

AIR COMPRESSORS

Size	Make	Type	Disp.	Press
12 x 10	Penn	DA	300	100
10 x 11	Worth	HB	294	125
10 x 10	Ing. R.	ERI	223	120
10 x 8	Ing. R.	ORI	179	85
9 x 8	Worth	HB	211	100
9 x 8	Ing. R.	ERI	145	100
8½ x 9	Worth	HB	170	100
7 x 7	Worth	HB	122	100

DIRECT CURRENT MOTORS 230 VOLTS

H.P.	Make	Type	Speed
375	Westgh.	Ped	850
200	Westgh.	SK210	900
200	Reliance	1970T	675
175	G.E.	ELC11	750
100	G.E.	HG34	2500
100	Westgh.	SK175	850
100	Al-Ch	EI02	575
40	G.E.	CO2004	600
35	Cr-Wh	CM351	700
35	G.E.	C	800
30	Westgh.	SK120	875
30	Cr-Wh	CCM	450
30	Westgh.	SK93	1750
30	G.E.	HC31B	1150
25	Westgh.	SK100L	1100
25	Westgh.	50	900
25	Al-Ch	K-130	700
20	Westgh.	SK83	1750
20	G.E.	HC	1150
20	G.E.	LC	575
20	G.E.	HC	900

CHANDEYSSON Anodizer

NEW 1000 AMP. 60 volt, type NPT, d/c 60 H.P. Chan. A-28 Syn. Motor 3/60/220, 600 RPM, 25 deg. cont.

ROTARY CONVERTER

1000 KW Westinghouse, 300 RPM, 600 V DC, 4700/4200 V AC, 6 HP, 60 cy. with complete starting equipment

CHICAGO ELECTRIC CARRIES COMPLETE STOCKS OF:

- A.C. MOTORS
- D.C. MOTORS
- M.G. SETS
- GENERATORS
- TRANSFORMERS
- CONTROLS
- COMPRESSORS
- HOISTS
- PUMPS
- SWITCHBOARDS

CALL CANAL 6-2900

First Source for 41 Years for Quality Electrical Equipment

CHICAGO Electric Co.

1320 W. CERMAK ROAD — CHICAGO 8, ILL.

MOTOR GENERATOR

125 KW, West. 275 volts DC to 200 HP synchronous motor, 220 or 440 volts 3 phase 60 cycles, direct connected exciter 1200 RPM 3 Pedestal Bearings complete control, factory built, used approx. 1000 hr.

WESTINGHOUSE DYNAMOMETER

225 HP 250 volts DC 300/2000 RPM Cradle Type Control and Dial Scale used approx. 1500 hrs.

ADJUSTABLE SPEED MOTOR

1—30 HP, GE type CD 1337, 230 V, DC, 300/1800 RPM. New.

CIRCUIT BREAKER

1—2000 Amp., West. DA-75, 440/3/60 New 1943—Used 3 Years.

DELL STEPHENSON & CO.

14456 Glastonbury, Detroit 23, Mich.
Phone: VErmont 5-0697

3—20 HP, Allis-Chalmers Electrifugal, Size 6L 220 or 440/3/60, 1750 RPM SP.PR. Cap. 1000 GPM 68' Head.

7—Ingersoll-Rand, Size 5 x 4, 500 GPM, 150' Head 3500 RPM with base and coupling for Frame 365-S Motor.

8—Morris Slurry Pumps, Size 1½, Mg. St., Imp. & Plates.

1—Milton Roy Chemical Proportioning Pump, 3" x 4" const. of Worthite with Hastelloy Valves, complete with 2 HP Master G.H. Motor.

1—5 HP, 5' Setting, Vertical Sump Pump, Size 2".

1—Beach-Russ, Vacuum Pump, 120 CFM, 15 HP V-Belt Drive.

1—Talor 4" Rotary Bronze Fitted, V-Belt Drive.

Motors—Air Compressors, Speed Reducers, and Vacuum Pumps. We solicit your inquiries and offerings.

C-B EQUIPMENT AND PUMP CO.

1440 N. B'way. St. Louis, Missouri
CE. 7976 CH. 1101

COMPLETE FAIRBANKS-MORSE POWER PLANT 431 KVA

2—240 HP 14x17 Modernized Diesel Engines, needle Bearing, open head, direct connected to 3/60/480V. F & M Alternators.

1—31 KVA Fairbanks-Morse Diesel Electric Light Plant.

3—Complete Switchboards; Woodward Governors; Complete Starting Equip; Maxim Silencers; Complete Cooling System; Crane Oil Purifiers; And other auxiliary equipment.

This Plant is a Bargain, Send for Full Data & Price.

GENERAL MACHINERY & EQUIPMENT CO., INC.

809 Woodland, Kansas City, Mo.
Victor 0018

FOR SALE

BOILERS

2—Heine 1000 HP Boilers, Nos. 8501, 8502, oil fired, 300 lb. pressure, with Engineering Co. controls, Type D #2053, 3½ x 18 tubes. All necessary valves, piping & controls.

INDUSTRIAL PLANTS CORP.

90 West Broadway N. Y. 7, N. Y.

25,000 KVA—20,000 KW, 80% P.F., 3 phase 60 cycle, 13,200 volts, 1800 RPM General Electric Company condensing turbine generator unit 215 P.S.I.G. 540-550° total temperature complete with direct connected shaft exciter, switchboard and instruments, a 30,000 square foot 2-pass Westinghouse surface condenser, motor driven and turbine driven pumps and condensing accessories.

ACTUAL PHOTOGRAPHIC VIEW

EXCELLENT CONDITION — COMPLETE INSTALLATION — PROMPT DELIVERY

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

8150 KVA G.E. condens., 3-stage, 2300/4000 volts, 200# P.S.I., 600°TT.

2500 KVA Westinghouse condensing 2300 volts.

2500 KVA G.E. Type ATB, Form HT, 2300/480 volts, 3600 RPM, two bearing alternating current generator LESS TURBINE.

2500 KVA G.E. condensing 200 P.S.I. 2400/4000/480 volts.

937 KVA G.E. bleeder condensing 215 P.S.I.G., 15# extraction, 2300 volts.

780 KVA Allis condensing, 150 PSI, 480 volts.

625 KVA G.E. non-condensing 150 P.S.I., 20# back, 480 volt.

625 KVA G.E.—Murray condensing 250 P.S.I., 2300 volts.

125 KVA G.E. non-condensing, 150-200 P.S.I., 2300 volts.

125 KVA Westghse. non-condensing 150/250 P.S.I. 2400 volts NEW

Direct Current

300 KW Westghse. 3-wire, 250 volt 150/250# P.S.I. non-condensing

150 KW (2) Westinghouse-Worthington, 250 volts, 3-wire, 225-250 P.S.I. condensing.

100 KW (2) G.E. 125 volt, 200/275 P.S.I. non-condensing

75 KW (2) Westinghouse-Moore, 120 volt, 200# P.S.I. condensing.

60 KW (3) new Westinghouse, 120 volt, 250# P.S.I. condensing.

MOTOR GENERATOR SETS

750 KW Allis-Chalmers 250 volt direct current generator direct connected to 1400 HP 3 phase, 60 cycle, 2300 volt synchronous motor.

150 KW G.E., 125 volt direct current generator connected 225 HP, 3 phase, 60 cycle, 220 volt, synch. motor.

100 KVA Westghse. 60 cycle, 2400 volts, 900 RPM alternator direct connected 135 HP, 230 volt direct current motor.

62½ KVA G.E., 60 cycle, 2300 volt alternator to 75 HP, 125 volt DC motor.

APRIL BARGAINS

SPECIALLY PRICED

22,500 sq. ft. Alberger — 21,000 sq. ft. Wheeler, 4,400 sq. ft. Worthington SURFACE CONDENSERS

3—10,000 GPM 24" suction 20" dis. Cent. pumps each direct connected motor.

1—10,000 GPM 24" suction cent. pump direct connected motor.

1—10,000 GPM 24" suction cent. pump direct connected G.E. non-condens. turbine.

1—5425 GPM, 70 foot head Centrifugal pump connected 125 HP 60 cycle, 2200 volt, 1750 RPM G.E. motor.

2—1000 GPM, 1270 foot head, 4-stage Morris pumps each connected 417 HP, 350# P.S.I. non-cond. G.E. turbine.

1—G.E. Bank of Scott connected 2 to 3 phase, 60 cycle transformers, 2500 KVA capacity.

1—20 KW 125 volt direct current generator connected Hill Diesel engine.

UNAFLOW GENERATOR UNITS

Alternating Current—3 phase, 60 cycle

625 KVA 40°C Rise, General Electric, 240 volts generator connected Skinner non-condensing engine, 150 P.S.I.

500 KVA G.E., 2400/480/240 volts generator connected Ames Vertical Engine, 150#.

375 KVA G.E., 2300/440 volts generator connected 23"x24" Skinner Horizontal Engine.

175 KVA Westghse., 240 volt generator connected Skinner Horizontal Engine, 125-150# P.S.I., 5# gauge back.

Direct Current

400 KW G.E. 250 volts, 360 RPM generator connected Skinner vertical engine 150#.

275 KW Westinghouse, 250 volt generator connected Ames vertical engines, 150#.

250 KW (2) G.E., 3-wire, 250 volts generators connected Skinner engines, 150#.

SYNCHRONOUS MOTORS

5000 KVA Westinghouse, 4000 volt, 720 RPM Electrical Synchronous (condenser).

900 HP Allis, 2200 volts, 150 RPM.

300 HP G.E., 80% P.F., 2300 volts, 720 RPM.

DIESEL GENERATING PLANTS

4—1200 HP, 8 cylinders Model 38D8½ opposed piston, 720 RPM, Fairbanks-Morse Diesel engines each direct connected to a 800 KW, 250 to 375 volts, 720 RPM compensated shunt wound enclosed Elliott direct current generators.

3—187 KVA, 3 phase 60 cycle, 240 volts, 400 RPM generators direct connected to 225 HP, 6 cylinders Buckeye Diesel Engines.

UMC UTILITIES MACHINERY CORP.

1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

WRITE FOR STOCK LIST No. 1622

VARIABLE VOLTAGE DRIVES

40 HP Reliance Variable Voltage Drive, each Consisting of:
1—40 KW 250 Volt Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 285T, 230 Volt, DC Motor.
With full magnetic control providing log forward, log reverse, run, fast, slow, and stop, and motor operated field rheostat.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	HP	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5301
2	10	1140	410	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11‡	820	550	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	18	680	440	West.	MW-316
1	20	860	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	550	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	865	440	West.	CW-646
1	30	350	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
2	35	600	400	F-M	HV-H18A
2	40	865	2200	Al.Ch.	ARY-223C
1	40	566	440	G.E.	MT-346
2	50	1150	440	G.E.	M-536
1	50	860	440	West.	HF-12A
1	50	570	440	G.E.	MT-353
5	52‡	550	220	G.E.	IQC-5013***
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW-938
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1770	440	G.E.	MTP-549
1	175	805	550	West.	CW-1002
1	200	495	2200	G.E.	IM-17A
1	250	600	2300†	G.E.	IM-17
2	300	900	140	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
2	350	1775	2300	G.E.	IM-E15A
2	350	880	2200	G.E.	IM-17A
1	400	505	550	West.	CW
1	600	1770	440	G.E.	IM-E15C
1	650**	360	440	G.E.	MT-442Y
1	700	735	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts. ‡‡Intermittent rating. ***2 phase.
**New. ‡125 cycle.
†Also 440 or 550 volts. *Also 440 or 2300 volts.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding & Direct Connected Exciter.

Qn	KVA	RPM	Make	Volts
4	18.7	1800	Columbia	240/120
4	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D.C. MOTORS

Qn.	HP	Speed	Make	Type
10	½	800	Reliance	Y-257
25	¾	850	West.	SK-30
1	7½	1150	G.E.	CDM-65
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al.Ch.	EB-80
2	10	850	West.	SK-83
10	13½**	600	West.	SK-103
3	15	1750	G.E.	CD-75
5	15	825	West.	SK-90
1	20	1740	L.A.	ONA-L851
1	20**	1450	G.E.	CDM-83
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
1	20**	1450	G.E.	CDM-38
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
1	60	1750/1310	West.	SK-143
1	150	700	Al.Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	HP	Speed	Make	Type
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-927
1	12½	230/340	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1300	G.E.	RF-11
1	20/25	100/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1300	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1300	West.	SK-143
1	40/50	400/1200	Reliance	T-4611
1	75	500/1500	Cr.Wh.	CCM
1	75	375/750	Cr.Wh.	
3	100	225/900	G.E.	MPC-125M
5	100	400/1200	Al.Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/500	West.	SK-220
2	375	350/500	G.E.	MPC

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
5	7.5	1740	440	G.E.	K-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1760	220	G.E.	K-365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	40	3565	440	G.E.	KF-4058

SPLASHPROOF, BALL BEARING

Qn.	HP	RPM	Volts	Make	Type
23	½	1750	440	L.A.	FS-254
1	½	1735	220	G.E.	K-254
1	½	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
2	50	1760	440	L.A.	FX-445A
6	50	1160	220	G.E.	K-504
1	150	1775	440	L.A.	FX-1168
1	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335

OPEN TYPE MOTORS

Qn.	HP	Speed	Volts	Make	Type
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-302
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-532
1	25	1800	220	G.E.	KT-312
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-358***
2	25**	875	440	Master	PB-495
2	25	575	440	G.E.	KT-542
3	30	3550	550	G.E.	K-3648
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP5-405
1	50	850	220	West.	CCL
1	60*	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-662C
4	75	870	220	West.	CS-756A
2	75	865	2300	G.E.	KT-352
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.Ch.	AN
2	125	435	440	Al.Ch.	AR
2	125	400	2300	G.E.	I-17-FR
1	200	580	550‡‡	G.E.	KT-5668
2	300	587	2200	West.	CS-39A
1	500	1200	140	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

220 volt motors can be reconnected for 440 volts. **New. ***2 Phase. ‡‡Reconnectable for 440 volts.

G. E. DYNAMOMETER

Cradle Type, with control and Dial Scale. (Write for Complete Specifications.)

Qn.	HP	DC Volts	RPM	Type
1	200	250	1200	C

MOTOR GENERATOR SETS

125 and 250 Volt D. C.

(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
2	Cont.	1750	125	220/440
7.5	West.	1455	125	380/220‡
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
10	West.	1150	250	220/440
12**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440‡
15	West.	1750	125	2200/440
25	G.E.	1200	125	2200/440
30	G.E.	1800	250	220/440
30	Al.Ch.	1750	125	220/440
50	G.E.	1720	125	220/440†
75	G.E.*	1200	125	220/240

Note: 3KW, 5KW & 7.5KW, 250V Sets Available. **New. *Synch. Motor Driven. ‡50 Cy. †25 Cy.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVE. CLEVELAND 14, OHIO

MOTOR GENERATORS

1—1000 KW G.E. Syn. 250 V. 720 RPM
1—300 KW G.E. Syn. 250 V. 1200 RPM
1—200 KW WEST. Syn. 250 V. 1200 RPM
1—200 KW ELLIOTT Syn. 125/250 V. 1200 RPM
1—200 KW RIDGWAY Syn. 250 V. 1200 RPM
1—100 KW G.E. Ind. 250 V. 1200 RPM

ROTARY CONVERTERS

1—500 KW G.E. Syn. 250 V. 1200 RPM HCC, 6 Ph., 60 Cy. Transformers.
2—300 KW G.E. Syn. 250 V. 1200 RPM HCC, 6 Ph., 60 Cy. Transformers.
1—300 KW WEST. Syn. 250 V. 1200 RPM 6 Ph., 60 Cy. Transformers.
1—150 KW G.E. Syn. 250 V. 1200 RPM HCC, 6 Ph., 60 Cy. Transformers.
1—150 KW WEST. Syn. 250 V. 1200 RPM 6 Ph., 60 Cy. Transformers.
1—150 KW RIDGWAY Syn. 250 V. 1200 RPM 6 Ph. 60 Cy. Transformers.

ARMATURES

1—500 KW G.E. 250 V. MPC Gen. 900 RPM
1—300 KW G.E. 600 V. HCC Conv. 1200 RPM
1—150 KW G.E. 250 V. MPC Gen. 1200 RPM

WALLACE E. KIRK COMPANY
502 Grant Bldg., Pittsburgh 19, Pa.

45,000 KW POWER PLANT AND 4 MILL-TYPE BUILDINGS

Immediately Available

Located on the main line of a trunk railroad, adjacent to low-cost fuel in the Appalachian bituminous coal area, in the center of excellent labor supply, this industrial plant on a 20-acre site is ready for immediate use. Power plant equipment includes:

Four 11,250 kw Westinghouse turbines, each capable of 11,000 volts, 25 cycle, 1500 rpm.
Fourteen Stirling boilers, stoker-fired, each capable of 50,000 lb steam per hour, 700,000 lb per hour total, 225 psig, 150°F.
Complete coal and ash-handling facilities.

All of the buildings, the power plant, and the utilities on the site are well maintained. Power capacity can be doubled by modernization at a relatively small capital outlay. Nearby properties available for plant expansion.

K. S. DENNY
340 Lantana Ave., Englewood, N. J.

FOR SALE

2—NEW—"WHEELER" 8,000 Sq. Ft. SURFACE CONDENSERS arranged for 2-pass operation

4—NEW—"WESTINGHOUSE" Size C-43 (Multi-Stage) AIR EJECTORS—SUITABLE FOR UNITS UP TO 8,000 Sq. Ft.

Attractively priced — Detailed Specifications available upon request.

J. A. DOUGHERTY
P.O. Box 90 Bala-Cynwyd, Pa.
Phone:—Cynwyd 4978

FOR SALE

1—200 H.P. B&W Straight Tube Boiler and type E STOKER, in excellent condition.

GEORGE D. HAAS
University of Rochester
Rochester 7, N. Y.

POWER PLANT BARGAINS

Boilers, water walls, stokers, turbo, steam and Diesel Electric units, transformers, air compressors and large motors.

Send your power problems and list of equipment available to:

BENJAMIN W. BISSELL, Reg. Engr.
521 K. of P. Bldg., Indianapolis 4, Ind.
Phone: Lincoln 4007

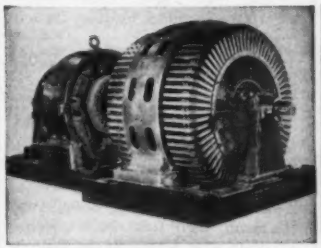
IT ISN'T RE-NU-BILT UNLESS

It Comes from

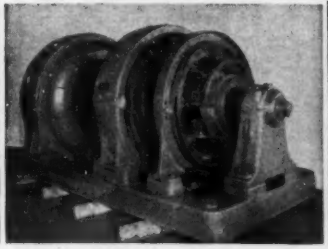
BELYEA

"SUCCESSFUL OPERATION GUARANTEED"

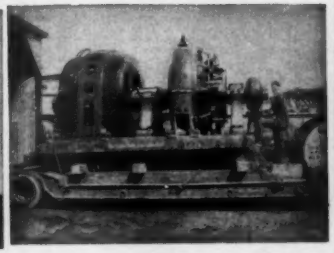
Three Recent Stock Arrivals



500 KW-MG



750 KW-MG



2000 KW-MG

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
2	2000*	G.E.	600		6600/11000
1	1500	G.E.	600	125/250	4000
1	1500	Whse.	600	600	2300/4000
1	1500	G.E.	360	275	2300/4400
1	1000	Whse.	900	600	2300/4150
1	1000	G.E.	900	600	2300/4150
1	800	Whse(3U)	1200	600	2300
1	750	Whse.	900	250	2300
1	500	G.E.	720	125	2300/4000
1	500	Whse.	900	250	440
1	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	400	Whse.	1200	250	2300
1	350	G.E.	900	125	2300/4150
1	150	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	Cr. Wh.	1200	250	440
1	140(3U)	Cr. Wh.	690	125/250	2300
1	100	G.E.	1170	125	220
1	100	Delco	1200	125/250	440
1	75	G.E.	1200	125	4000
1	75	G.E.	1200	250	440
6	70	G.E.	1200	70	220/440
1	60	G.E.	1200	250	2300
1	50	Whse.	1200	120	220

* 25 Cycle

ROTARY CONVERTERS

60 Cycles

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	2000	G.E.	514	600	13800
1	1000	Whse.	900	600	11000
1	750	Whse.	900	600	12300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	2500	G.E.	Condensing—150# ISP 2300 V 3 ph. 60 cy. with surface condenser. Recently Rebuilt.
1	1000	G.E.	Condensing 135/150# ISP 2300/4150 V 3 ph. 60 cy.
2	750	G.E.	Condensing 425#-715°TT ISP-440V-3 ph. 60 cy. New—1944
1	625	Whse.	Non-condensing, 125/150# ISP, 5/20# B.P., 480 v., 3 ph., 60 cy., with exciter
1	400	Whse.	Non-condensing 125/150# ISP 5/10# BTU 40/480v. 3 ph. 60 cy.
2	400	G.E.	Condensing. 275# ISP. Geared to 1200 RPM. 120/240V. D.C. Generator.
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM 120/240V. D. C.
2	200	Cr. Wh.	Condensing 250# ISP GEARED to 1200 RPM—125V. D.C. Gen.
1	200	Whse.	Non-condensing 150# ISP 7# B.P. 240V. 3 ph. 60 cy.

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1750	Whse.		600	525/720
1—1500	Whse.		525	600
1— 940	Whse.	QM-R.Brg.	250	140/170
1— 800/1000	Whse.		450	600/720
1— 850	G.E.	MPC	250	115/145
1— 600	Al. Ch.	MUL	230	400/800
2— 450	Whse.		550	415
1— 300/400	G.E.	DYNA	250	1325/2500
1— 350	Cr. Wh.	CCM-151H	230	1100
1— 325	Whse.	MQ	250	300/900
1— 200/300	G.E.	MPC	230	300/920
1— 275	Whse.	QM-600-6	230	425/850
1— 250	G.E.	MPC	230	450/560
1— 150	G.E.		600	250/750
10— 150	Cr. Wh.	85H	230	590
1— 150	Cr. Wh.	CMC-85H	230	1150
1— 150	Cr. Wh.	CCM-152H	230	300/1050
1— 50/120	G.E.	MCF	230	250/1000

FREQUENCY CHANGERS

1—1000	A.C.	25/82½	Cycle		2300/2300
1—1000	G.E.	25/58	Cycle		4400/2300
1— 500	A.C.	25/60	Cycle		11000/2300V

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse.		4800	720

TRANSFORMERS

60 Cycles

Qu.	KVA.	Make	Type	Ph.	Voltages
3	2666	Whse.	OISC	1	6600/11000
1	1500	G.E.	HT	3	13800x480
3	1250	G.E.	H	1	6900x2300
1	1050	G.E.	WCTH	3	11000x445
1	800	Al.Ch.	OISC	3	4000/2300x310
1	500	Whse.	OISC	1	2400x455
1	500	Whse.	OISC	3	13800x230/460
3	333	Pitts.	OISC	1	26400x2800
6	250	G.E.	HT	3	13200x240/480
3	250	G.E.	HT	3	6900x240/480
9	250	G.E.	HT	3	2400x240/480
3	150	Maloney	OISC	1	13800x2300/4000
1	100	G.E.	H	1	460x230

RECTIFIERS

1— 750	G.E.	BHW	575	2300
1—1000	A.C.	B-613	625	13500
1—1000*	A.B.B.	GRZ	625	6900/13200

*This unit with full automatic control good for both 25 and 60 cycle.

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—2500	G.E.	TS	2300	257
1—2100	G.E.	ATI	4000	514
2—3000	Whse.		2300	120
1—1470	Whse.		4000	900
2— 900	Al. Ch.	(New)	2300	150
1— 650	Whse.	G	2300	138
1— 600	Whse.	Syn.	440	200
1— 450	Whse.	Mag.	2200	128.5
2— 350	G.E.	TS	2300	150
1— 300	G.E.	ATI	440	720
1— 300	Whse.		2300	720
1— 225	G.E.	ATI 1-Brg.	440	900
1— 125	G.E.	ATI	440	450
1— 100	Whse.		550	600

SLIP RING

1—1000	Whse.	CW	2300		444
1— 700	Whse.	CW	2300		900
1— 500	G.E.	IP	550		2405
1— 500	G.E.	IM-Mill	2300		450
1— 850	G.E.	MT-442-Y	2300/4000		253
1— 300	Al. Ch.	3 Brg.	2300		205
1— 300	G.E.	IM	440		1760
5— 300	Al. Chal.	ANY	2300		720
1— 250	Al. Chal.	ANY	440		585
1— 250	G.E.	M-567-TSFC	440		600
1— 250	G.E.	MT-434Y	4000		257
1— 250	G.E.	MT-559S	2300		1750
1— 250	Al. Chal	ANY	550		600
1— 200	Al. Ch.	ANY	440		600
3— 150	G.E.	IM-15	440		600
1— 150	Al. Chal.	ANY	440		580
1— 125	G.E.	MT-566Y	440/2300		435
4— 100	G.E.	MT-566Y	440/2300		435
2— 100	G.E.	IM-16	2300		435
1— 100	G.E.	IM	440		600
1— 100	Al. Ch.	ANY	440		695

SQUIRREL CAGE

2— 650	G.E.	FTS585Y	440		2570
2— 450	Whse.	CS	2300/4150		354
1— 200	G.E.	IK-17	440		880
1— 200	G.E.	IK	550		880
1— 200	G.E.	T-557	2300		1760
1—300/112	G.E.	KF-559BS	440	1170/585	
1— 150	Wrights.	CS4548	440		885
1— 200	G.E.	IK	440		880
1— 125	Whse.	MS	440		885
1— 125	(New) G.E.	KF-TSFC	440		1180
1— 125	G.E.	KF-TSFC	440		2585
2— 125	Al. Ch.	ARW	2300		1750
1— 125	G.E.	IK	220		900
1— 100	Al. Ch.	AR	2300		1170
1— 100	G.E.	IK-Vert.	2300		450
3— 100	G.E.	KT-543	220/440		1750

RE-NU-BILT BELYEA MOTORS

BELYEA COMPANY, Inc.

43 HOWELL ST., JERSEY CITY, N. J.

PHONE - JOURNAL SQUARE 2-3334

N. Y. LINE - RECTOR 2-7150

WAGNER
CERTIFIED REBUILT

ELECTRIC MOTORS & GENERATORS
Backed by 45 Years of Quality & Service

M-G SETS

KW	Mfr	Input V	Output V
300	G.E.*	440 AC	275 DC
200	Whse*	2300 AC	275 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Century	220/440 AC	125 DC
150	Gen. Elec.*	2200/440 AC	600 DC
150	Cr. Wh.*	220/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Delco (3)	220/440 AC	125/250 DC
100	Allis Ch.* (2)	2200/440 AC	60 DC
100	Delco b.b.*	2200/440 AC	125/250 DC
100	Gen. Elec.	220/440 AC	125 DC
100	Gen. Elec.	220/440 AC	250 DC
75	Gen. Elec. (2)	220/440 AC	250 DC
75	Gen. Elec. (3)	220/440 AC	125 DC
65	Whse.	220/440 AC	250 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Allis Ch. (2)	220/440 AC	125/250 DC
50	Gen. Elec.	220/440 AC	250 DC
45	Cr. Wh. b.b.	220/440 AC	125 DC
40	Whse. (2)	220/440 AC	125 DC
40	G.E.	220/440 AC	250 DC
35	Cr. Wh. b.b.	220/440 AC	125 DC
30	G.E.	220/440 AC	48 DC
25	Gen. Elec.	220/440 AC	250 DC

*Syn. motor drive.

D. C. MOTORS

HP	Mfr	Type	Volts	Speed
200	Reliance	1970T	230	575/750
150	Cr. Wh. TEFC	83H	230	890
100	Whse.	SK181	230	450/900
100	Gen. Elec.	C	230	575/1000
100	Gen. Elec.	CD125	230	850
75	Gen. Elec.	RCF-32	230	1700
75	Gen. Elec.	BC	230	1800
75	Northw'n	K20	230	1750
75	Whse.	SK160	230	850
75	Cr. Wh. b.b.	CMC-HH	230	1150
60	Cr. Wh.	50H	230	700
60	Reliance b.b.	651T	230	730
50	Whse.	SK	230	1750
50	Gen. Elec.	R.C. 14	230	1050
40/60	Whse.	SK160	230	500/1000
40	Gen. Elec.	BC-32	230	1150
40	Cr. Wheeler	EH	230	1750
40	Whse.	SK110L	230	1750
40	Whse (2)	SK130	230	950
35/50	Gen. Elec.	CD123	230	575/1150
30	Whse.	SK110L	230	1150
25/30	Cr. Wh. b.b.	FH	230	575/1725
25	Whse.	SK150	230	300/1200
25	G.E. b.b. (2)	CD93	230	1150

- EXPLOSION PROOF MOTORS—
- GEARHEAD MOTORS, AC & DC.
- FREQUENCY CHANGERS.
- CIRCUIT BREAKERS, AC & DC.
- SPEED REDUCERS.

D. C. GENERATORS

HP	Mfr	Type	Volts	Speed
300	Gen. Elec. 1brg.	DMC	275	720
300	Reliance	1870T	250	720
150	Cr. Wh. b.b.	83H	250	1150
105	Century b.b.	1500 amp	70	1200
100	Gen. Elec.	CD	250	1200
100	Gen. Elec.	C	250	750
100	Gen. Elec.	DLC	125/250	675
75	Gen. Elec.	RC	250	1200
75	Gen. Elec.	RC36	125	1200
65	Whse.	SK160	250	1150
60	Gen. Elec.	LC	250	700
50	Allis Ch. (2)	EW	125/250	1200
50	Gen. Elec.	R.C. 14	250	1200
50	Cr. Wheeler	50H	250	900
45	Cr. Wh. b.b.	FH	125	1750
40	Whse.	SK	250	1200
35	Gen. Elec.	CD	250	1500

A. C. MOTORS—25 CYCLE

HP	Mfr	Type	Volts	Speed
150	Whse.	HF	440	500
60	Allis Ch.	AHY	440	1500
60	Gen. Elec. Int.	MTC5337	440	750
50	Gen. Elec.	I-K	440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	750
500	Allis Ch.	3 brg.	240/480	720
300	Gen. Elec.	ATB	600	720
275	G.E. 25 cycle	ATI	480	750
250	Whse.	G	2400/480	900
236	Gen. Elec.	ATB	240/480	900
225	Gen. Elec.	ATB	240/480	900
187	Gen. Elec.	ATB	240/480	900
158	Elec. Machy.	3 brg.	240/480	514
125	Gen. Elec.	ATB	240/480	720
125	Gen. Elec.	ATB	240/480	300
100	El. Machy.	B.B.	2400	900

A. C. MOTORS—SLIP RING
3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
1—	600	Gen. Elec.	I-M	300
2—	500	G.E. New 2300V.	M514Y	900
1—	500	G.E. 3 brg.	I-M	450
1—	450	Gen. El. 2200V.	I-P	1200
1—	300	Whse. 2300V.	CW	600
1—	300	Gen Elec. 2300 V.	MM66	900
1—	300	G.E. b.b. New	I-M	1800
1—	250	Allis Ch. 2200V.	ANY	514
1—	250	Cr. Wheeler	SB	600
1—	200	G.E. 2200V.	I-M-16	600
1—	150	Gen. Elec.	I-M	1200
1—	150	Gen. Elec. 2200V.	I-M-16	900
1—	150	G.E. 2300/4000V.	I-M	1200
1—	150	Gen. Elec.	I-M-17	450
1—	125	Gen. Elec.	I-M-15	720
1—	100	Gen. Elec.	I-M	1800
1—	100	G.E. Vertical	MT583	1200
1—	100	Gen. Elec.	IM-15A	514
1—	100	Northwestern	HW75A	900
1—	100	Gen. Elec.	I-M	720
1—	100	Cr. Wheeler	SB	600
1—	75	Gen. Elec.	I-M-14	720
1—	75	Gen. Elec.	MT558	600
1—	75	G.E. 2200V.	MT556	720
1—	75	Gen. Elec.	MT537	1800
1—	75	Whse. 2200V.	CW	600
1—	60	Fair. Morse	BV	720
1—	60	Whse. 2200V.	CW716C	900
1—	50	Allis Ch.	ANT	900
1—	50	Howell	6R437	1200
1—	50	Gen. Elec. Int.	ITC5013	600
1—	50	Gen. Elec.	I-M	720
1—	50	Gen. Elec.	MT336	1200
2—	40	Whse.	CW536A	1200

A. C. MOTORS—SYNCHRONOUS

HP	Mfr	Type	Volts	Speed
600	Gen. Elec. (2)	TS	2200	514
300	Whse.		2200/440	300
300	Whse.	G	2200/440	600
300	Gen. Elec.	ATI	440	720
275	G.E. 25 cycle		220/440	750
250	Gen. Elec. (2)	TS	220/440	300
220	G.E. 3 brg. .8PF	ATI	220/440	600
200	G.E.	TS	220/440	150
220	G.E. .8PF	ATI	220/440	900
150	El. Machy.	3 brg.	220/440	514
150	Gen. Elec.	ATI	220/440	720
150	Gen. Elec.	ATI	220/440	600
130	Gen. Elec.	ATI	220/440	300
100	American b.b.	YGH	220/440	900
125	El. Machy. (2)	B.B.	2400/4800	900

A. C. MOTORS—SQUIRREL CAGE
3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
2—	500	Fair. Morse 2200V.	HS	1200
1 —350		Gen. Elec.	I-K-17B	600
1—	325	Gen. Elec.	KT420	400
1—	300	G.E. 2200V.	KTP561	1800
1—	300	Allis Ch. 2200V.	AN	720
1—	250	Gen. Elec.	FT549AZ	2600
1—	250	Gen. Elec.	FT549	2600
1—	200	Allis. Ch.	AN	1200
1—	200	Whse. b.b. NEW	CS875	1800
1—	150	Gen. Elec. TEFC b.b.	K6333S	1200
1—	150	Reliance b.b. NEW	B6085	1200
1—	150	Gen. Elec.	KF557	1200
1—	150	Gen. Elec. 2200V.	IK-EI8A	1800
1—	125	Reliance b.b. New	C5085	1200
1—	125	Con. 2200V. b.b.	8G	1800
1—	125	F.M. 2200V. vertical	UH-16D	1200
1—	100	Ideal	AA	600
1—	100	Gen. Elec.	I-K	720
1—	100	Allis Ch. 2200 V.	ARS26	1200
1—	100	Rel. TEFC NEW	C5085	1200
188	75	Gen. Elec. b.b. NEW	K5048	1800
1—	75	Fair. Morse b.b.	HJQ	900
1—	75	Reliance b.b. NEW	C8084	900
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen. Elec.	KT329Y	2600
1—	75	Reliance b.b. NEW	C505	1200
1—	75	Gen. Elec.	I-K-14	600
1—	75	G.E. Expl. Pf.	K6285	1200
1—	75	F. Morse b.b.	NEW	720
1—	60	Gen. Elec.	I-K	600
1—	60	G.E. 2200V.	KT532	1800
1—	60	G.E. hiterq	KG504	1200
1—	60	Reliance b.b. NEW	B504	1800
1—	60	Reliance TEFC NEW	C505	1200
1—	60	Whse. H.T.	C8504	1800
1—	50	Rel. TEFC New	B1478	1800
1—	50	Gen. Elec.	KT346	720
1—	50	Gen. Elec.	KT356	450
2—	50	G.E. Vertical	KT356	720
1—	50	Reliance b.b. New	CC504U	900
1—	50	L.A. 2200 V. Ex. p.f.	E5048	1800
1—	50	Gen. Elec.	KT336	1700
1—	50	Whse.	CR	1200
1—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
1—	50	Whse. hiclip	WL807	900
1—	50	Allis Ch. 2200V.	AR445	1200
2—	40	Gen. Elec.	KT42	720

QUICK SHIPMENT FROM STOCK — LOW PRICES — FULL GUARANTEE
Send for Complete Stock Lists

Arthur Wagner Co.
1825 W. RANDOLPH ST. MOnroe 6-7801 CHICAGO 7, ILLINOIS

BOILERS

1—1300 H.P. WALSH-WIDENER Boiler, Sectional Header, Cross Drum, 225#.

1—600 H.P. B.&W., Cross Drum, 160#, Steel Headers, 1932.

1—375 H.P. B.&W., Cross Drum, 160#, Sectional Header.

1—250 H.P. B.&W., Cross Drum, 160#, Sectional Header, Detroit Stoker.

1—25000# B.&W. FF Boiler, 250#, 1941, INTEGRAL TYPE.

1—286 H.P. Hodges, HRT, 150#, 1942. Peabody Oil burners and Dual Pump set.

2—250 H.P. ERIE CITY 3 drum, Bent Tube, 200#, 1940.

2—250 H.P. B.&W., 3 drum, Low Head, Bent Tube Boilers, complete with Single Retort Detroit Stokers, all trim, 100°F Superheaters.

1—40 H.P. Erie City, 150#, 1939, Front Plate and Ray Oil Burner, Electric Boiler Feed Pump.

3—9.7 H.P. BROWNELL Boilers, 100#, 1948. Injector, TODD Rotary RA Burner. Separate Oil Burner Pump and motor. Fully automatic for $5 oil.

1—80 H.P. Kewanee, 250#, complete.

1—75 H.P. LOEFFEL SCOTCH, 100#, 1936. Ray 209 h.p. Rotary Oil Burner 3/60/220.

1—250 H.P. TITUSVILLE Double Corrugated Furnace Scotch Marine Boiler and Oil Burner, 150#.

1—RILEY RO, 20,000 lbs at 160# pressure.

1—B. & W. FF, 40,000 lbs at 200# pressure.

1—250 H.P. KEWANEE, 1942, 125# pressure.

1—Kelly Stoker

2—B. & W. Chain Grate Stokers

1—Western Precipitator

1—B.&W. Sterling V2-28-470—3¼" tubes. Cap. 39,500# per hr. 200#. No superheat. Three 36" steam drums, 1—36" mud drum.

1—B.&W., F16, Boiler, 30,000# per hr., 425#, 700° steam temperature, 3265 sq. ft. heating surface. 778 sq. ft. in water walls. B.&W. Pulverizers. One steam, 1 electric Feedwater Pump. All trim & controls.

WARNER J. SHERB, INC.
342 MADISON AVENUE
NEW YORK, N. Y.
Telephone MUrray Hill 2-9098

WORLD'S LARGEST INVENTORY

Established 1934 — D & B Rated

ELECTRIC EQUIPMENT CO., ROCHESTER, N.Y.—APRIL BULLETIN

MOTOR GENERATOR SETS
AC — DC

Quan.	KW	Make	Volts
1	1000	General Electric	250
6	1000	General Electric	600
2	500	Westinghouse	250
2	500	Westinghouse	1500
1	500	Westinghouse	125
1	400	Westinghouse	125/250
2	300	General Electric	125/250
1	250	General Electric	600
1	250	General Electric	250
1	200	Westinghouse	250
1	200	General Electric	250
2	200	General Electric	125
1	150	General Electric	250
1	150	General Electric	125
2	100	General Electric	125
4	100	General Electric	250
1	100	Allis-Chalmers	125/250

Plus 238 sets from 1 KW to 75 KW in stock.

DC TO AC

Input	Output
1 800 HP—230 V	200 KW, 440/60/3
1 125 HP—230 V	75 KW, 125 V, DC
1 25 HP—230 V	15 KW, 230/60/3
1 25 HP—230 V	15 KVA, 230/60/1
35 20 HP—230 V	12½ KVA, 440 V, 3 ph, .8 P. F.
40 7½ HP—230 V	7½ KVA, 120/60/1
22 6 HP—115 V	5 KW, 120/60/1
6 3 HP—115 V	2 KVA, 110/25/1
10 1½ HP—115 V	1 KVA, 110/60/1
10 1 HP—115 V	½ KVA, 110/60/1

ROTARY CONVERTORS

Quan.	KW	Make	Speed	Volts
5	500	General Electric	1200	250
7	400	Westinghouse	1200	250
1	100	General Electric	1200	250

P.S.—We Stock Explosion-Proof Motors—Class 1-D & 2-G

AC GENERATORS—ALTERNATORS—CONDENSERS

Quan.	KVA-HP	RPM	CYCLE
1	2500	720	60
1	2500	900	60
1	1675	600	40
2	1500	900	60
1	1430	514	60
1	1250	1200	60
1	1000	750	25
1	800	900	60
3	750	900	60
2	650	139	60
1	500	720	60
1	500	750	25
1	400	450	60
3	400	1800	60
1	350	750	25
1	350	720	60
1	350	225	60
1	333	1800	960
1	320	1200	120
1	300	750	25
1	300	180	60
1	250	720	60

Plus 78 smaller units from 3 KVA to 200 KVA

60 CYCLE MOTORS
SQUIRREL CAGE MOTORS

HP	SPEED	MAKE
500	720	G. E.
400	1200	West.
400	514	West.
300	600	West.
250	3600	G. E.
250	1200	G. E.
200	600	Al. Ch.
200	1800	Wagner
150	720	G. E.
150	600	G. E.
150	1200	Al. Ch.
150	1800	Al. Ch.

P.S. We stock 3500 new and rebuilt 1 HP to 100 HP

SLIP RING MOTORS

Quan.	HP	Speed	Make
1	600	1800	G. E.
1	500	1800	G. E.
1	500	514	Al. Ch.
4	500	900	G. E.
1	350	720	G. E.
1	300	450	G. E.
1	300	514	G. E.
1	300	900	G. E.
1	300	720	G. E.
1	200	600	G. E.
1	200	1200	G. E.
2	150	720	G. E.
1	125	1200	Al. Ch.
1	100	900	Wagner
4	100	450	G. E.
3	75	720	West.

Plus 827 smaller units 1 HP to 40 HP

TRANSFORMERS

Quan.	KVA	Primary Volts	Secondary Volts	Phase
2	3000	23,000	2300	3
1	1500	2,300	600	3
1	1000	2,300	220	3
6	1000	66,000	7200	1
3	750	2,400	480	1
6	500	2,400	480	1
3	500	12,000	2300	1
3	450	23,000	440	1
3	333	2,400	600	1
3	333	2,400	240/480	1
3	333	13,200	240/480	1
3	333	11,500	240/480	1
3	300	2,400	120/240	1
6	250	2,400	240/480	1

Plus 734 smaller units 1 KVA to 100 KVA

DC MOTORS
ADJUSTABLE SPEED—230 VOLT

Quan.	HP	Make	Volts
1	300	General Electric	400/800
1	250	West.	250/675
4	40/250	West.	540/3600
1	150	West.	300/600
1	100	Reliance	500/1500
1	100	G. E.	400/1000
1	100	West.	450/1350
1	100	G. E.	1050/4000
1	90	F. M.	500/1500
1	75	G. E.	400/1200
1	60	G. E.	220/1000
1	60	G. E.	300/1200
1	50	G. E.	250/1000
1	50	G. E.	400/1200
1	40	G. E.	250/1000
1	40	Cr. Wh.	400/1600
1	35	West.	250/1000
1	35	G. E.	500/1000
1	30	Reliance	400/1200
1	30	Cr. Wh.	500/1500
1	25	Reliance	400/1600

Plus 327 smaller units 1 HP to 20 HP

CONSTANT SPEED—230 VOLT

HP OR KW	MAKE	SPEED
400 HP	Elec. Dyn.	1600
300 KW	G. E. (170 V)	1200
300 HP	Cr. Wh.	1200
250 KW	Al. Ch.	720
150 KW	West.	720
125 HP	Star	1200
100 HP	G. E.	900
75 HP	G. E.	1200
75 KW	G. E. 825 V	1200
50 HP	West.	1200
50 HP	Burke	1800

Plus 675 smaller units 1 HP to 40 HP also 115 V & 550 V, DC.

SQUIRREL CAGE AND SLIP RING—25 CYCLE

Quan.	HP	Speed	Make
1	650	365 rpm	S.R.
1	350	750	S.C.
1	300	750	S.C.
1	300	375	S.R.
4	200	500	S.R.
1	200	750	S.R.
1	200	750	S.C.
1	200	500	S.C.
1	200	1500	S.C.

Plus 872 smaller units 1 HP to 150 HP

COMPRESSORS

1—3000 CFM	Ingersoll—Steam
1—3000 CFM	Sullivan
1—1350 CFM	Ingersoll
2— 850 CFM	Ingersoll
2— 400 CFM	Chicago
2— 196 CFM	Ingersoll

We stock new units 6 CFM to 230 CFM

Note: We Stock 6000 New Motors, Controls, Frequency Changers

SEND US YOUR INQUIRIES!

ELECTRIC EQUIPMENT COMPANY

PHONE LD 65

New and Rebuilt — ROCHESTER, N. Y. — 1 H. P. to 2500 H. P.

MOTORS · MG SETS · TRANSFORMERS · CONTROLS · COMPRESSORS

BREW-WOLTMAN OFFERS

TURBINE UNITS

1—12500 KVA Allis Cond. 60 cy. 13800 V. 900-lb.
1—10000 KVA G.E. Cond. 25 cy. 6600 V. 200-lb.
1— 5000 KVA West. Extr. Cond. 60 cy. 480 V. 385-lb.
1— 3125 KVA G.E. Cond. 60 cy. 2300 V. 150-lb.
1— 2500 KVA Worthington Non-C. 60 cy. 2300 V. 150-200-lb. 40-lb. SP
1— 2500 KVA G.E. Cond. 60 cy. 2300 V. 125-150-lb.
1— 2500 KVA G. E. Extr. Cond. 60 cy. 480 V. 185-200-lb. steel valve sheet.
2— 2250 KVA G. E. Cond. 60 cy. 240-480 lb.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lb.
2— 1250 KVA Elliott Cond. 60 cy. 480 V. 150-200-lb. 650° Surface Condenser
1— 938 KVA G.E. Extr. Cond. 60 cy. 240 V. 200-lb.
1— 750 KVA G.E. Extr. Cond. 60 cy. 480 V. 200-lb.
1— 625 KVA West. Cond. 60 cy. 480 V. 150-lb.
2— 250 KVA Elliott Non-C. 60 cy. 208 V. 200-lb. 5-lb. SP
1— 75 KW West. Cond. 125/250 V. DC 400-lb.

DIESEL ENGINE UNITS

3—1400 HP Fair. Morse 2400 V. 60 cy.
1— 900 HP Amer. Loco. 250 V. DC
3— 700 HP Gen. Motors 2300 V. 60 cy.
3— 650 HP Amer. Loco. 440 V. 60 cy.
2— 600 HP Amer. Loco. 250 V. DC
1— 600 HP Fair. Morse 2400 V. 60 cy.

STEAM ENGINE UNITS

1—500 KVA Skinner Uniflow 440 V.
1—250 KVA Ames Vertical Uniflow 400 V.
1—250 KVA Ames Uniflow 480 V.
3—187 KVA Ames Vertical Uniflow 240/480 V.
1—156 KVA Ames Vertical Uniflow 240 V.

ROTARIES—60 CY.

QU.	KW.	MFR.	VOLTS-DC	TRANS.	RPM
1	3250	G.E.	225/285	13800	300
1	2000	A.C.	600	4150	514
2	1000	West.	600	4150	720
1	1000	G.E.	600	13200	900 Auto.
2	500	West.	250	13200	1200

SPECIALS

TURBINE UNITS

2—1250 KVA, Elliott 3/60/480 V. 3600 RPM 150-200 lbs. IP 600° TT with dir. conn. exciter, surface condenser & pumps.

1—1250 KVA, Allis Chalmers 3/60/2300 V. 3600 RPM, 200-lb. IP 500° TT with 25 KW motor generator exciter and condenser.

MERCURY ARC RECTIFIERS

QU.	KW.	KIND	DC VOLTS	TRANS.
2	4500	Multi Anode	600	13800
2	1850	Ignitron	250	33000
1	1000	Ignitron	600	13800

MOTOR GENERATOR SETS—60 CY.

QU.	KW.	MFR.	VOLTS-D.C.	A.C.	RPM
1	1500	West.	250	4600	514
1	1000	G. E.	600	13200	514
1	500	West.	125	2300	720
1	400	G. E.	250	6600	720
1	300	G. E.	250	2300	1200
1	300	G.E.	125	2300	1200
1	75	Star	240	440	1200
1	75	West.	125	440	1200

SYNCHRONOUS CONDENSERS

QU.	KVA	MFR.	VOLTAGE	RPM
1	2500	G.E.	2400/4160	720
1	2000	West.	2300	720
1	1500	G.E.	4600	900
1	1500	West.	2300	900
1	1000	West.	2300	900

SYNCHRONOUS MOTORS—60 CY.

QU.	HP	MFR.	VOLTAGE	RPM
1	4350	Cr. Wh.	13800	514
1	1000	E. M.	2400	720
2	750	West.	2300	200
1	500	G.E.	440	300
2	350	G.E.	2300	257
1	300	G.E.	2300	600
1	300	West.	2300	900

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	3125	G. E.	25/60	300
1	3000	G. E.	60/25	300
2	2500	G. E.	25/62½	750
1	2450	G. E.	62½/25	750
1	1250	G. E.	25/60	300
1	1250	West.	25/60	300
2	1000	G. E.	25/60	300
1	500	Al. Ch.	25/60	300

TRANSFORMERS—60 CY.

1— 7500 KVA G.E. 138000—41000, 3 ph.
3— 3333 KVA West. 132000—7620/13200 Y
1— 2000 KVA G.E. 69000—13800/23900 3 ph.
3— 1000 KVA West. 66000—7200
3— 500 KVA G.E. 2400—2400
1— 2500 KVA G.E. 50/73 KV, 5 taps, 3 ph.
3— 75 KVA G.E. 44000—2300/4000
3— 8333 KVA West. 43800—13800
4— 6667 KVA G.E. 38100/66000Y—12700/22000 Y/13200
1—18750 KVA A.B.B. 34640—11000, 3 ph.
2— 7500 KVA Al. Ch. 33000—13800, 3 ph.
6— 200 KVA G.E. 33000—2300/4000
6— 167 KVA G.E. 33000—2300/4000Y
6— 75 KVA Mal. 33000/19500—2300/4000
3— 75 KVA Wag. 33000—7200/12470 Y
6— 50 KVA G.E. 33000—2300
3— 4500 KVA G.E. 27000—2300, 3 ph.
3— 3750 KVA West. 26400/13200—2400
1— 450 KVA Al. Ch. 25410/44000—13200/23000
4— 1000 KVA G.E. 22000/11000—2300, 3 ph.
3— 750 KVA West. 13200—440
3— 333 KVA G.E. 13200—240/480
5— 200 KVA G.E. 13200—440
3— 200 KVA G.E. 11500—220/110
3— 200 KVA Mal. 11000—2300
1— 1500 KVA West. 4000—2300, 3 ph. Auto
3— 200 KVA A.C. 2400—120/240
3— 100 KVA Kuhl. 550—229/110
3— 75 KVA G. E. 480—120/240

OIL CIRCUIT BREAKERS

4— 400 A. 154 KV G.E. FHKO-39-2500 Outdoor
1— 600 A. 132 KV G.E. FHKO-80-1500 Outdoor
2— 600 A. 73 KV G.E. FHKO-138-1000 Outdoor
1— 400 A. 73 KV G.E. FHKO-236-500 Outdoor
1— 600 A. 37 KV G.E. FHKO-138-450 Outdoor
2— 400 A. 37 KV G.E. FHKO-236-500 Outdoor
4— 600 A. 15 KV G.E. FHKO-138-750 Outdoor
3— 600 A. 15 KV West. B-28-B-500 Indoor

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50 Church Street New York City 7, WOrth 4-1470

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BOILER

Water Tube. Babcock & Wilcox, 1945. 2 Drum, Bent Tube, Economisers. Internal Desuperheater. Superheaters: W.P. 400 P.S.I. Hydrostatic Press. 718 P.S.I. Heating Surfaces: 2441 sq. ft. Superheater 350 sq. ft. Economiser 1620 sq. ft. 3 Todd "Hex Press" Fuel Oil Burners. Diamond Soot Blowers. Auxiliaries available.

BOILER

Mfr. Vancouver Iron Works, Vancouver, B. C. Type: Yarrow, 3 Drum, Bent Tube, Water Tube, Oil fired. 4 Burners, 55,000 lbs. steam per hr. Max. Heating Surface 6256 sq. ft. Working Press. 225 P.S.I. Test Press. 387 P.S.I. Built 2/7/43.

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New and used equipment recently released from service by a number of electric and gas utility companies

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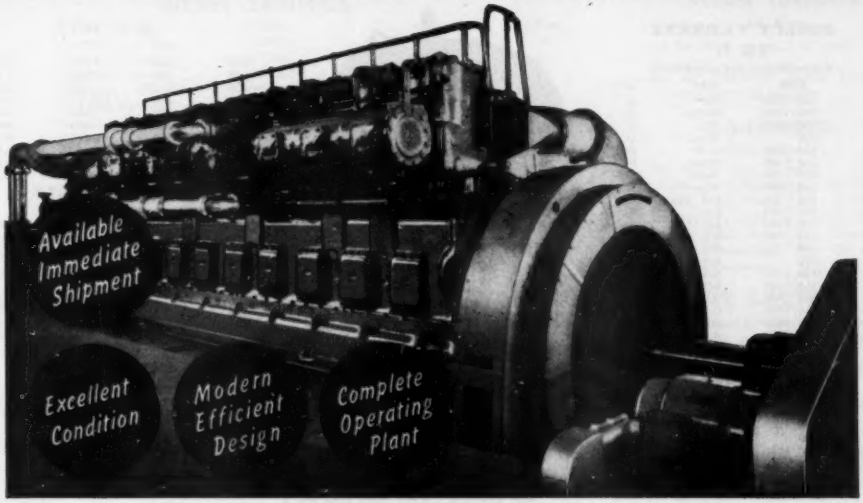


1675 KVA Fairbanks-Morse Diesel Generator Unit

1250 KW 80% P.F. 1675 KVA 50° Fairbanks-Morse alternating current generator 3 phase 60 cycle 2400/600/480 volts, 300 RPM direct connected to

1750 HP Fairbanks-Morse Diesel Engine, 2 cycle, 10 cylinders, Model 83E16, 300 RPM.

The above unit is complete with direct connected exciter, switchgear, starting equipment, heat exchanger, air scavenger, pumps, oil reclaimer, Maxim silencer and inter-connecting piping and fittings as in operation.

STEAM TURBINE GENERATOR UNITS

3 Phase 60 Cycle

7,500 KVA Westinghouse condensing, 200 lbs. steam pressure, 600° FTT, 2300 volts, with surface condenser.

5,000 KVA Westinghouse condensing double extraction, 400 lbs. steam pressure, 600° FTT, 125 lb. and 20 lb. extraction, 480 volts, with surface condenser.

3,500 KVA New General Electric condensing extraction, 400/600 lb. steam pressure, 550° FTT, 20 lb. extraction, 480 volts, with surface condenser.

1,250 KVA General Electric noncondensing, 150-250 lb. steam pressure, 600° FTT, 0-50 lbs. exhaust, 2400 volts.

1,250 KVA Westinghouse condensing extraction, 150-250 lb. steam pressure, 600° FTT, 5-25 lb. extraction, 480 volts, with surface condenser.

625 KVA Westinghouse non-condensing, 150-200 lb. steam pressure, 600° FTT, 25 lb. exhaust, 480 volts.

SPECIAL
NEW 2859 KVA VARIABLE FREQUENCY GENERATORS
3 Phase 60/240 Cycle

3—2000 KW 70% P.F. 2859 KVA New General Electric A.C. generators, 3 phase, 240 cycle, 4150 volts, type ATB-6, 4800 RPM. Can be operated at lower frequencies with proportionate reduced speeds.

UNIFLOW ENGINE GENERATOR UNITS

3 Phase 60 Cycle

750 KVA Allis Chalmers-Ames vertical, 150 lb. steam pressure, 5 lb. exhaust, 2400/4160 volts.

625 KVA General Electric-Skinner horizontal, 150 lb. steam pressure, 5 lb. exhaust, 240 volts.

375 KVA General Electric-Skinner horizontal, 150 lbs. steam pressure, 5 lbs. exhaust, 480 volts.

250 KVA General Electric-Ames vertical, 150 lb. steam pressure, 5 lb. exhaust, 480 volts.

STEAM BOILERS

1,000 HP Springfield water tube boiler, 300 lb. steam pressure, with Westinghouse underfeed stoker.

720 HP (2) Combustion Engineering water tube boilers, 450 lb. steam pressure, with Coxe chain grate stokers.

600 HP Connelly water tube boiler, 200 lbs. steam pressure, with Taylor underfeed stoker.

DIESEL ENGINE GENERATOR UNITS

3 Phase 60 Cycle

1,675 KVA Fairbanks-Morse, 2400/600/480 volts, 300 RPM.

900 KVA Fairbanks-Morse, 2400 volts, 257 RPM.

546 KVA Worthington, 480 volts, 327 RPM.

312 KVA Worthington, 208 volts, 450 RPM.

Write, Wire or Phone for Further Details and Prices

INTERNATIONAL POWER MACHINERY CO.

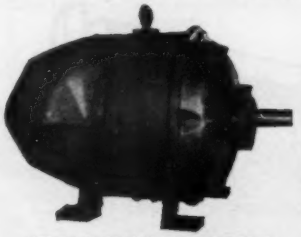
UNION COMMERCE BLDG. **Telephone: MAin 1-9514** **CLEVELAND 14, OHIO**

MOTORS - M.G. SETS - CONTROLS

NEW AND GUARANTEED REBUILT

DIRECT CURRENT
230 V.
Reconditioned and guaranteed

HP	RPM	Mfg.	Brgs.
150	250/1000	Rel	Sl.
75	300/1200	Whse.	Sl.
50	500/1500	G.E.	Sl.
50	1150	Whse.	Sl.
40	400/1600	C-W	Ball
40	400/1600	Imper.	Ball
35	400/1200	Ideal	Sl.
30	250/1000	Whse.	S.Sl.
30	400/1200	Rel (TE)	Ball
30	500/1500	Rel	Ball
30	700/1400	Rel (TE)	Ball
25	250/1000	G.E.	Sl.
25	600/1350	Rel	Ball
25	690	Rel	Ball
25	1150/2300	G.E. (TE)	Ball
20	300/1200	Rel	Ball
20	500/1500	G.E.	Sl.
15	250/1000	G.E.	Sl.
15	400/1600	Whse.	Sl.
15	400/1200	G.E.	Sl.
15	575/1000	Rel	Ball
15	575/1725	L.A.	Ball
15	650/1650	G.E.	Sl.
15	700/1350	Rel	Ball
10	400/1600	Whse	Sl.
10	400/1600	Rel	Ball
10	600/1200	Rel (TE)	Ball
10	850	Rel	Ball
7½	200/1200	Whse. (TE)	Ball
7½	400/1600	Rel	Ball
7½	400/1600	Whse.	Ball
7½	600/1800	Rel (TE)	Ball
7½	1150	G.E.	Sl.
5	450/1800	Whse.	S.Sl.
3	850/1700	Rel	Ball



NEW DIRECT CURRENT
230 volt-drip proof.

Qu.	HP	RPM	Mfg.	Frame
1	3	690/2660	G.E.	284
10	5	850/1700	G.E.	CD-66
5	7½	575/1725	G.E.	CD-77
1	10	575/2300	L.A.	4051
3	10	1750	Rel.	T-34

CRADLE TYPE DYNAMOMETER
225 HP, Whse, 250 v. DC, 300/2000 RPM, complete with Toledo automatic printing type scale and all necessary control.

NEW MAGNETIC SLIP RING CONTROLS
4—ALLIS 250 HP, 440 volt (125 HP, 220 volt) Reversing, 7 accel. steps, main line air ckt. brkr., fully magnetic, open or enclosed.

M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	250	2300	G.E.
400	125/250	2300	Ideal
125	250	220/440	Whse.
100	250	2300	G.E.
50	250	440	Ideal
30	250	440	Ideal
20	250	220/440	G.E.
3VS	250	220/440	Rel.

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
650	128	2300	Whse.	Engine
400	900	2300	Whse.	80%
300	450	2300	G.E.	100%
300	720	550	G.E.	80%
250	200	440	G.E.	100%
250	514	2300	Allis	80%
200	720	440	G.E.	100%
200	1200	440	G.E.	100%
150	600	440	G.E.	100%
100	1800	2300	Whse.	100%

SLIP RING

HP	RPM	Volts	Mfg.
500	1200	220/440	Elliott (new)
400	900	2300	G.E. (new)
350	450	2300	Whse.
300	600	440	G.E.
200	450	2300	Burke
200	900	220/440	G.E. (new)
100	900	440	G.E. (new)
75	1200	440	G.E. (new)
50	720	220	Whse.
50	900	220	G.E.
40	900	220	G.E.

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WAlbridge 1195

BOSWICK ELECTRIC CO.

P.O. BOX 55 AKRON 9, OHIO

MOTORS - M. G. SETS - COMPRESSORS, ETC.

FAST SHIPMENT

MOTOR GENERATOR SETS
3 ph. 60 cy.

KW	MAKE	RPM	D.C. VOLTS	A.C. VOLTS
500	Cr. Wh.	720	250	2300
400	West.	720	550	2300
300	Ridg.	1200	250	2300
300	G.E.	1200	250	4000/2300
300	West.	1200	550	4000/2300
200	Ridg.	900	250	2300
200	G.E.	1200	250	4000/2300
150	Ridg.	900	250	2300
100	G.E.	1200	250	2300
100	Ridg.	1200	250	2300/440
75	West.	900	75	440/220
35	G.E.	1800	125	440/220

Also Smaller Units in Stock

ROTARY CONVERTERS

KW	MAKE	RPM	D.C. VOLTS	A.C. VOLTS
500	G.E. HCC6	1200	250	4000/2300
300	G.E. HC12	600	250	4000/2300
300	G.E. HCC6	1200	250	4000/2300
150	G.E.	1200	250	4000/2300

Other sizes available

AIR COMPRESSORS
741 CFM, 100#, OCB, Chg. Pr. belted 150 HP motor.
500 CFM, 100#, Allis Rotary direct connected 100 H.P. B.B. Motors.

A.C. MOTORS—3 Ph. 60 Cy.

HP	MAKE	RPM	TYPE
300	G.E.	450	IM—Sl.Rg.
200	G.E.	1200	MI—Sl.Rg.
160	G.E.	600	IK-16—Sq. Cg.
150	West.	514	CS954—Sq. Cg.
150	G.E.	600	ATI—Syn.
100 (2)	Allis	720	ARX—Sq. Cg.
100 (4)	West.	1200	CS752C—Sq. Cg.
100 (2)	G.E.	450	IM16—Sl.Rg.
75	West.	900	MS342 Sq. Cg.
75	G.E.	600	ITC5013A
50	West.	1750	CS
50	Al. Ch.	1750	
50/12.5	G.E.	900/450	IM 2200 v.
40	G.E.	1200	MT336—Sl.Rg.

Also Smaller Units in Stock

D.C. ADJUSTABLE SPEED MOTORS
250 Volts

HP	MAKE	SPEED	TYPE
150	West.	400/800	SK201
125	West.	450/1000	SK193
60	West.	435/870	SK185
50 (2)	Elec. Dyn.	190/760	

Also Smaller Units in Stock

Send us your inquiries for any POWER EQUIPMENT you may require.

MOORHEAD ELECTRICAL MACHINERY COMPANY

361 Noblestown Road Oakdale, Penna. Pittsburgh District

TRANSFORMERS — FOR SALE
1 Phase 60 Cycle
Rebuilt and Guaranteed

3—1250 KVA—G.E. 13800 2400
3—1000 KVA—G.E. 13800 480
3—1250 KVA—G.E. 6900 480
3—1000 KVA—G.E. 4800 480
6— 500 KVA—West. 2400 240/480
9— 333 KVA—West. 6900 480
9— 333 KVA—West. 4800 480
9— 333 KVA—West. 2400 480
3— 200 KVA—G.E. 2400 480/240
3— 150 KVA—G.E. 2400 480/240
3— 100 KVA—G.E. 2400 480/240
3— 100 KVA — G.E. 6900/11950Y 460/230
3— 75 KVA—West. 4800/2400 460/230
3— 50 KVA—G.E. 4800/2400 460/230/115
3— 37½ KVA — G.E. 4800/2400 460/230/115

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BUFFALO TRANSFORMER CO.
1510 NIAGARA ST.
BUFFALO 13, N. Y.

LIQUIDATION SALE — Modern Equipment

DIESEL ENGINES

HP	MAKE	MODEL	RPM	CYCLE
1800	General Motors	16-2SB5	900	4
1800	General Motors	16-278A	720	2
1800	Fairbanks Morse	38D O/P	720	2
1800	Hamilton	RB99-D.A.	700	2
900	General Motors	12-567 ATL	750	2
900	General Motors	6051 (quads)	650	2
500	Superior	6-cyl.	514	4
450	General Motors	6046 (Twins)	2100	2
215	Superior	VDM B	600	4

DIESEL GENERATOR SETS

DC	1200 KW	525V	750 RPM	General Motors	16-278A	
	650 KW	240V	750 RPM	General Motors	12-567	
	125 KW	120/240	600 RPM	Superior	VDMB	
	100 KW	120/240	1200 RPM	General Motors	3-268A	
	60 KW	120V	1200 RPM	Buda	909	
AC	200 KW	3/60/450	1200 RPM	General Motors	8-268A	rebuilt
	100 KW	3/60/450	1200 RPM	General Motors	3-268A	rebuilt

3—150 KW 3/60460 600 RPM Buckeye model 80 diesel

6—100 KW 3/60/460 600 RPM Worthington BS5 diesel
With Westinghouse generators, exciters, cooling systems, starting equipment, switchboard, silencers, etc. Units practically new.

TURBO-GENERATORS—D.C.

1—375 KW 180/240 V GE Shunt. 1200 non-cond.
5—300 KW 120 V Whse. Compd. 1200 cond.
1—300 KW 240 V GE Compd. 1200 cond.
12—150 KW 120 V Whse. Shunt. 1200 cond.
12— 60 KW 120 V Whse. Stab. Sh. 1800 cond.
1— 25 KW 125 V 3600

MOTORS—DC

1500 HP 525 V DC 600 RPM W'hse.
1362 HP 415 V DC 1200 RPM Elliott
867 HP 375 V DC 1200 RPM Elliott
444 HP 250 V DC 900 RPM Elliott
222 HP 230 V DC 3050 HP W'hse
50 HP 230 V DC 525/1800 W'hse.
15 HP 120 V DC 500 RPM Diehl

GENERATORS—DC

1200 KW 525 V 750 RPM All. Chalm.
1075 KW 375 V 750 RPM Elliott
700 KW 240 V 500/720 Elliott
375 KW 240 V 1200 W'hse.

AIR COMPRESSOR

2000 CFM at 90 psi, 3 stages, driven by 450 HP diesel mfr. Clark Bros.

HIGH PRESSURE AIR COMPRESSORS
CENTRIFUGES
EVAPORATORS
TRANSFORMERS
SOOT BLOWERS
WINCH TYPE MOTORS

MODERN TURBO GENERATORS AC

1—2000 KW 3 phase 60 cycle 3600 RPM 480/600/2400/4160V type ATB-2 Form HL driven by steam turbine, 410# steam pressure, exhaust 2½" Hg abs., 275 deg. F superheat. General Electric Company. (also 2900 at 1700 V)

2—250 KW G.E. type ATI 3/60/450 1200 RPM condensing.

2—200 KW Westinghse. 3/60/450 1200 RPM condensing (unused).

6—200 KW G.E. type ATB 3/60/450 1200 RPM cond. and non-cond.

GENERATORS—AC

3—2000 KW 3/60/480/600/2400/4160 3600 RPM type ATB-2 Form HL. Mfd. by G.E.

MOTORS—AC

4—6000 HP at 25-1/3 cycle 400 RPM or 3600 HP at 60 cycle 257 RPM—G.E.

ICE PLANTS (New)

2—22 ton capacity, Freon 12, mfd. by Frick.

BOILERS

2—Cyclotherm 3000 pounds steam per hour, 125# press.

1—Express Boilers, modified D type, Foster Wheeler 30,000# steam/hr., 435#.

2—Type "D", water tube, Foster Wheeler, 15000# steam/hr., 275# press.

STEAM TURBINES

All New

1—110 HP 250# steam, 10# each. 1200 RPM Sturtevant

10—58.5 HP, 300-475# steam, 10-15# each. 1225-1600 RPM, Sturtevant

CONDENSERS

(Most are new)

No.	Sq. Ft.	Make	Passes	Tubes	
2	8000	C.H.Wheeler	2	Brass	¾"
4	3380	Str. Wells	2	Alu-Brass	¾"
4	1050	Consoco	2	Cu Ni	⅝"
30	400	All. Chalm.	2	Brass	⅝"
4	300	Wheeler	2	Cu Ni	⅝"
8	155	Consoco	2	Brass	¾"

AIR EJECTORS

1—Foster Wheeler for 3800 sq. ft. cond.
5—Westinghouse type C-42, for 9300 sq. ft. condenser.
2—Ingersoll Rand 275# press., for 8250 sq. ft. condenser.
2—C. H. Wheeler, type 4H240, for 8000 sq. ft. condenser.

HYDRAULIC PUMPS

Vertical quintuplex pumps, 450 GPM, 1750 psi, 128 RPM, mfr. Aldrich, with 700 HP 3/60/2300 motors.

AXIAL FLOW FANS

16,000 CFM 3" S.P. 3/60/440 Buffalo
12,000 CFM 3" S.P. 3/60/440 Clarage
35,000 CFM 1" S.P. 230V DC Wing

BLOWERS — AIR PUMP

5—Blowers, Roots Connersville, size 16x18, serial No. 14882, capacity 5000 CFM against 6 lb. sq. in. gg. pressure or 3450 CFM when creating 20" Hg vacuum.

1—Air Pump, Ingersoll Rand, type PS548, 3500 CFM, discharge press. 24.22 abs., intake press. 20.81 abs., with 125 HP motor 3/60/2300.

1—Air Pump, Ingersoll Rand, type PS548, 6000 CFM, discharge press. 20.86 abs., intake press. 17.10 abs., with 150 HP motor 3/60/2300.

1—Blower, Buffalo, size 60, type B, with 150 HP motor 3/60/2200.

WIRE ROPE SLINGS

Dia. from ⅝" to 2½"
Length from 10 ft. to 150 ft.

HOISTS

15—15,000# pull at 78 FPM, 3360# pull at 348 FPM and 2 auxiliary drums. Driven by Chrysler 20.35 H.P. gasoline engines. (NEW).

HEAT TREATING FURNACES

BOILER FEED PUMPS
FIRE, IRRIGATION AND GENERAL SERVICE PUMPS
OXYGEN PRODUCING PLANTS
WELDING ELECTRODES
REDUCTION GEARS

HUGO NEU CORPORATION

31 Nassau Street New York 5, N. Y.

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MOTORS • GENERATORS • TRANSFORMERS

200 KW M.G. SET

200 KW Westinghouse NEMA Frame Generator 250 V DC 1200 RPM direct connected to

300 HP Westinghouse Synchronous Motor 3/60 220/440 Volts 1200 RPM.

AC & DC Panels—Like new. Ship now.

1—400 KW Westinghouse 500 V. DC 750 RPM. 800 Amps. Motor—580 HP. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. DC. Direct connected to 50 HP. 3/60/440/1800 Gen. Elect. Motor.

600 HP GEAR REDUCER

1—600 HP Farrel-Birmingham Herringbone Gear Unit. Type SL. Size 30/16 Speed 730 RPM to 115 RPM.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP Gen. Electric Type KT 3/60/2300/1200 RPM.

150 HP Gen. Electric Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/720 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP Gen. Electric Type KT 3/60/440/600 RPM.

250 HP Gen. Electric Type KT 3/60/440/720 RPM.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

MOTORS

250 HP Gen. Electric Synchronous Type ATI 3/25 cycle/2200/500 RPM.

350 HP Westinghouse Slipring Type CW, 3/25 cycle/2200/500 RPM.

400 HP Westinghouse, Synchronous 3/60/2300/900 RPM.

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing.

Will make 1200 RPM 125 Volt Generators.

REBUILT TRANSFORMERS

3—100 KVA G.E. 1 ph., 60 cy., 2400/4160 pri., 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy., 23,000 pri., 575 sec.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

Most all units still on foundation. Many may be seen operating

DIESEL UNITS

240/440, 2300 Volts

1600 KVA Elliott-De LaVergne
300 KVA Fairbanks Mare
250 KVA GE-Buckeye
210 KVA (2) Wghse.-Buckeye
200 KVA Fairbanks Morse
187 KVA GE-Buckeye
75 KVA (2) General Motors
50 KVA (2) Fairbanks Morse
225 HP Buckeye (belted)

TURBO GENERATOR UNITS

Condensing—Bleeders

7500 KVA Al. Chal. 3/60/2300 V.
5750 KVA Wghse. 3/60/600 V. (Bleeder)
2500 KVA GE 3/60/600 V. Cond.
1625 KVA Wghse. 3/60/2300 V. (Bleeder)
1250 KVA Wghse. 3/60/2200/4150 V. (450#)
1250 KVA GE 3/60/480/240/600 V. (Bleeder)

937 KVA GE 3/60/600 V. Cond.
750 KVA Al. Chal. 3/60/480/240 V.
625 KVA GE 3/60/2300 V. (Bleeder)
625 KVA Wghse. 3/60/600 V. Cond.
375 KVA Wghse. 3/60/240/480 V. Cond.

TURBO GENERATOR UNITS

non-condensing

375 KVA (2) Al. Chal. 3/60/240/480 V.
250 KVA GE 3/60/2300/600 V.
125 KVA GE 3/60/240/480 V.
62 KVA GE-DeLaval 240/480 V.

STEAM ENGINE SETS, A.C.

480/240 volts

625 KVA GE-25x32 Chase 4 V.
450 KVA GE-Ames Unif. (Cond.)
450 KVA GE-23x28 Chase 4 V.
375 KVA GE—23x24 Skinner Unif.

312 KVA GE-22x24 Ames Unif.
312 KVA (2) CW-23x24 Skinner Unif.
219 KVA GE-18x20 Ames Unif.
187 KVA Wghse.-Ames Unif. (Vertical)
62 KVA GE-13x14 Ames Unif.

BOILERS

300 HP Cleaver Brooks 150# (New)
435 HP B&W—F-15; 425#
332 HP (2) B&W type H 100#
220 HP (2) Vogt 3 Dr. Low Hd. 188#
200 HP Erie City self contained 100#
150 HP (3) Murray, low Hd. 250#

TRANSFORMERS

500 KVA (3) Pittsburg 6600/550 V.
400 KVA (3) Wghse. 2300-230/460 V.
333 KVA (3) Pittsburg 2300-230/460 V.
250 KVA (3) G.E. 11430/6600-575V.
200 KVA (2) Wghse. 2300/460 V.

Above listed units are only a few of our "SPECIALS". Advise your plant requirements.

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt St.
New York, N. Y.

FOR SALE

4—600 A FK44B, 1—600 A FKR-255-150 G. E. Metalclad 15 KV Breakers—Like new.

1—200 KVA—2400/4160—220/440 G. E. Type H Form KSA Pyranol Transformer 1 ph.—New.

1—G. E. MPC 125/190 HP—260/400 RPM—230 V. D. C .Motor—Rebuilt.

1—G. E. ATB 750 KW—300 RPM—600/3/60 3 Brg. Generator

10—G. E. 3 KVA—3000/5200-115/230, Type HS 1 ph. Transformers—New.

WHITE ELECTRIC MOTORS LOWELL, MASS.

MOTOR GENERATOR SETS

FOUR (4)—75 KW, Century, DC Generators, 250/125 volts (3 wire), 1200 rpm, coupled to; Century squirrel cage, 3 phase, 60 cycle, 220 or 440 volt motors.

These are 4 bearing units, ball bearing, drip-proof construction, with DC panels.

EMPIRE ELECTRIC COMPANY, Inc.
87 Jay Street, Brooklyn, N. Y.
MAIN 4-5900

Our 30th Year

HEMPHILL EQUIPMENT PROVES ITS VALUE

Member of The National Industrial Service Association, Inc.

TRANSFORMERS—60 Cycle

Qu.	KVA	MAKE	TYPE	Ph.	VOLTAGES
1	1500	GE	Pyranol	3	4150x230/200
1	1000	GE	Auto	3/2	4150 x 2400
1	1000	GE	Auto	3	2810Y-2300Y
1	800	Kuhl.	OISC	1	4600 x 2300Y
3	400	GE	H	1	6900 x 2250V
1	300	Fitz.	ODSC	1	7800 x 440V
3	250	Maloney		1	13,800 pri., 220/440 sec.
1	200	Whse.	Auto	3/2	4150 x 2300
1	200	Fitz.	OISC	1	4000 x 110/220
1	200	GE	Auto	3/2	4150 x 2465
1	150	GE	HT	3	4150-120/208Y new
1	150	GE	KS	1	2300 x 230
1	100	Fitz.		1	2750 x 110/220
3	100	Wagner	RCKV	1	240 x 120/120
2	100	Whse.	SK	1	4400 x 220/440 Taps
2	100	Newark	Dry	3/2	440 x 220

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

Qu.	KW	MAKE	SPEED	DC	AC
1	1000	GE	514	600	2300/4150 Sys
1	300	GE	1200	250	2300 Syn.
1	150	GE	1200	125/250	2300 Syn.
1	150	Whse.	900	125	4150 Syn.
1	125	CW	1300	125	2300 SC
1	100	CW	1200	125	220/440 SC
1	100	El.Mach.	1200	125	4150 Syn.
2	75	GE	1200	250	220/440
2	75	GE	1200	125	220/440 SC
6	75	GE	1200	60	220/440 SC
1	50	Whse.	900	250	220/440 SC
2	40	El.Mach.	1750	125	440 SC

SLIP RING

1	2500	GE	MT	6600	257
1	300	Whse.	CW	440	600
1	250	Whse.	CW	440	600
1	200	Whse.	CW	440	600
1	100	GE	IM	440	400
1	75	GE	MT	220	1200 Vert
1	75	GE	MT	440	900
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1720
1	50	GE	MT	220	1200
1	50	Whse.	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	600
1	40	GE	MT	220	1200
1	40	GE	MT	2300	1200

SPECIAL—Welding Motor Generator Set

1—176 KVA Whse. Welding Gen. Set, 1 Ph. 220V, 800 Amp 57% PF with Slip Ring Motor & Exiter

J. L. HEMPHILL & CO.

This Seal is *Your Guarantee*

1604 53rd STREET, NORTH BERGEN, N. J.
PHONE NEW YORK — LONGACRE 5-3227
PHONE NEW JERSEY — UNION 3-2600

PARTIAL LISTINGS OF EQUIPMENT AVAILABLE FOR YOU

MOTOR GENERATOR SETS
3 Ph. 60 cycle

KW	DC Output	AC Input	Speed	Make
1800	250	2300/4000	600	G.E.
800(3U)	400/600	2300	1200	Whse.
400	250	220/440	1200	G.E.-W
300	250	440	1200	Whse.
300	250	2200	1200	A-C
300	250	440	900	G.E.
200	250	440	1200	G.E.
100	250	4300	1200	Whse.
75	125	440	1200	G.E.
50	250	220	1200	A-C-W
50	125	440	1800	C-W
32	125	440	1800	G.E.
25	230	220	1200	Rel.-G.E.
22	125	220	900	A-C
20	125	220	900	G.E.-A-C
12½	230	220	1800	Whse.
10	250	220	1800	Whse.
7½	250	220/440	1800	Whse.
7½	125	220/440	1200	Whse.
5	230	440	1200	Whse.
1	115	220/440	1800	G.E.

ROTARY CONVERTERS

KW	DC Volts	AC Volts	RPM	Make
1700	250	*	514	G.E.
1100	250	*	720	G.E.
300	600	33000	1200	Whse
150	250	*	1200	Whse.

*Will wind for any voltage

SYNCHRONOUS MOTORS
3 Phase, 60 Cycles

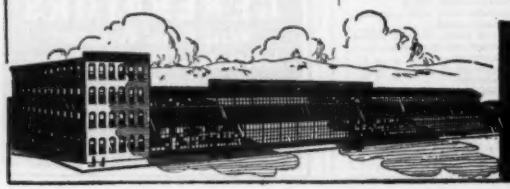
HP	RPM	Volts	Mfr.
3000	720	4800	Whse.
500	514	440	G.E.
435	720	2300	G.E.
430*	750	2300	Whse.
320	900	2300	G.E.
300	1800	2300/4160	G.E.
250**	225	2200	G.E.
225	900	4100	G.E.
220	600	2300	G.E.
220	277	2300	Whse.
200**	150	220	G.E.
175**	225	220	G.E.
160	600	440	G.E.
160	164	440	G.E.
150	1800	2200	G.E.
150	1200	220	Whse.
150	900	440	Star
150*	300	220	Chandeyson
130**	225	220	E-M
115	164	220	G.E.
115	164	220	G.E.
100	1800	2200	Whse.
100	1200	220	Whse.
95	1200	220	Burke
75	1200	220/440	Delco
75	900	2300	G.E
60**	360	2200	G.E.
60	300	220	E-M
50	1200	220/440	Delco
50	900	220/440	Whse.
50	720	440	G.E.
50**	300	220/440	Whse.

*25 cycles.
**Rotor and stator only, engine type.

SLIP RING MOTORS
3 Phase, 60 Cycles

HP	RPM	Volts	Mfr.
500	900	440	G.E.
500*	900	2200/4160	G.E.
375	1800	2300	A-C
350	514	220/440	G.E.
300	1200	440	Whse.
300	720	2200	A-C
300	600	440	G.E.
250	600	440	A-C
250	300	2200	A-C
235	1800	220	G.E.
200	1800	440	A-C
200	440	440	A-C
150	1800	440	G.E.
150	900	2200	A-C
150	720	440	G.E.
150	600	440	A-C
100	1200	440	Whse.
100	720	440	A-C
100	400	440	G.E.
75	720	440	A-C
75	600	440	A-C
60	1800	220/440	A-C
60	900	440	A-C
50	1200	220	F-M
50	900	440	Whse.
50	720	440	A-C
45	1200	440	Whse.
40	1800	220/440	Whse.
40	900	220	A-C
40	720	2300	A-C
40	600	220	G.E.
40	450	220	Triumph

*New.



GLOW ELECTRIC CO.
927 HARRIET ST CINCINNATI 3, OHIO
PHONE MAIN 3024

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
500	2200	G.E.	450
450	440/220	Whse.	514
400	2200	G.E.	1200
250	2200/440	G.E.	450
200	440	Whse.	3600
250	440/220	Whse.	600
250	2200/550	G.E.	450
200	550/440	G.E.	1200
200	440	G.E.	450
200	440	G.E.	450
188	4000/2300	G.E.	1800
150	440/220	Whse.	600
150	440/220	Whse. (3)	1800
145	4000/2300	G.E.	1800
125	550/440	G.E.	1200
100	440/220	G.E.	600
100 (3)	440/220	Whse.	900

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2300/400	G.E.	TS	720
300	440/220	G.E.	ATI	600
300	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
250	4000/2000	El. Mchy.	Syn.	600
240	2300/440	G.E.	ATI	720
200	440/220	G.E.	TS	720
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

PLATING UNIT

1—5,000 amp., 4/6 volt (or 2,500 amps., 8/12 volts) A.P. Munning, double commutator, dir. conn. to 50 hp, G.E. sq. cage motor.

CIRCUIT BREAKERS

2—2000 amps., GG E, 3 pole, 600 v., air
2—1600 amps., ITE, 3 pole, 600 v., air
2—1200 amperes, Whse., 3 pole, 600 v., air
1—4000 amp., 37500 V., G.E., Type FHKO-238 outdoor type, high interrupting capacity.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
650	440	G.E.	FT	3600
500	2300/4000	Elliot	SC	1800
350	2300	G.E.	KT	1200
300	2300	G.E.	FT	3600
300	440	G.E.	IK	720
300	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
200	2300/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2300/440	G.E.	KT	1200
200	440/220	G.E.	IK	450
150	440/220	Whse.	CS	900
150	440/220	G.E.	IK	450
100	2300/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTF	1200
150	440/220	G.E.	IK	514
150	2300/440	G.E.	KT	600
100	2300/440	G.E.	K	1200
75 (5)	550	G.E.	KF	1800

A. C. GENERATORS

1—320 kva, 600 rpm, 2300/440/220 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—225 kva, 720 rpm, 2300/440 v., G.E.
1—150 kva, 900 rpm, 440/240 v., G.E.
1— 75 kva, 1800 rpm, 480/240 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
350	230 (2)	G.E.	CD	1150
250	230 (3 new)	Cr. Wh.	CMC	1800
150	230 (2)	Whse.	SK	850
150	230	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	635
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—200 kw, 1200 rpm, 250 V., Whse., conn. to 250 hp, 1200 rpm, 2300 v. sq. cage
1—165 kw, 1200 rpm, 240 v., G.E., conn. to 250 hp, 1200 rpm, 440/230 v., squirrel cage
1—100 kw, 250 v., Hertner, 1200 rpm, connected to 150 hp, 220/440 v., synchronous
1—75/90 kw, 250 V., 1200 rpm, G.E. conn. to 125 hp, 440/220 V. sq. cage
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2300/440 v., syn. motor.
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/220 V., sq. cage

TRANSFORMERS 60 Cy.

2—333 kva, G.E., 13,200—2300 V.
3—333 kva, Whse., 3460—480/240 V., Dry
2—250 kva, G.E., 6900/13,800—230/460 V.
3—250 kva, Whse., 11,000/22,000—3300 V.
3—250 kva, Whse., 2300—208 V.
3—200 kva, Whse., 13,200—2300 V. (Inertsen)
6—150 kva, Al. Chal. 2400—240/120 v.
1—150 kva, Whse, SK, 13200-125/115 v., 3 ph.
3—100 kva, Whse., 4600/2300—230/115 V.
6—100 kva, G.E., 4600/2300-230/115 v., NEW
3—100 kva, G.E., 450-115/230 v., dry, 1 ph, new
3—75 kva, G.E., 480—240/120 v., Pyranol
3—50 kva, G.E., 480—240/120 V., Pyranol

STEPHEN HALL & CO.
HARRY J. RICE PRES.
458 SEVENTH ST. HOBOKEN, N. J.

POWER PLANT EQUIPMENT
SPECIAL OFFERINGS

TURBO-GENERATORS

2—4000 KW, 4160 V., 60# NEW
2—4000 KW, 2300 V., 150# Cond.
1—3500 KW, 2300 V., 150# Cond.
1—3500 KW, 4000 V., 150# Cond.
1—3000 KW, 4000 V., 150# Cond.
1—2500 KW, 480 V., 150# Cond.
1—2500 KW, 550 V., 250# Cond.
1—2000 KW, 550 V., 175# Cond.
1—1500 KW, 2300 V., 200# Cond.
1—1250 KW, 2300 V., 225# Cond.
1—1000 KW, 2300 V., 285# Cond.
1—1000 KW, 4150 V., 200# N.C.
2—1000 KW, 480 V., 100# Cond.
1—1000 KW, 460 V., 150# Cond.
1— 750 KW, 550 V., 170# Extr.
1— 750 KW, 2300 V., 175# Extr.
1— 500 KW, 2300 V., 170# Extr.
1— 300 KW, 2000 V., 150# Cond.
1— 300 KW, 2300 V., 200# N.C.
1— 150 KW, 2400 V., 150# N.C.

ENGINE GENERATORS

1—600 KW, 2300 V., Unit.
1—500 KW, 230 V., D.C., Unit.
3—375 KVA, 550 V., Unit.
1—312 KVA, 440 V., Unit.

REFRIGERATION UNITS

3—600 ton motor or turbine driven

BOILERS

2—50,000#, 300#
1—30,000#, 425#
1—35,000#, 150#
2— 600 HP, 250#
2— 500 HP, 400#
1— 458 HP, 250#
2— 400 HP, 150#
1— 150 HP, 150# So. Mr.

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.
THE BUYERS MUST BE SATISFIED—ALWAYS

EMERGENCY AND STANDBY GENERATORS

NEW— —SURPLUS

Diesel, Gasoline or Motor Driven
1 to 1,000 KW
Motors, Controls, Transformers, Switch Gear

BOUGHT • SOLD • RENTED

Department P

Midwest Utilities Power Equipt. Corp.
1270 W. Augusta Blvd., Chicago 22, Ill.
Everglade 4-4511

-TRANSFORMERS-

BOUGHT AND SOLD

We carry a large stock of transformers, and invite your inquiries.

PIONEER TRANSFORMER REBUILDERS

We rewind, repair and redesign all makes and sizes.

One Year Guarantee.

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
SINCE 1912 CINCINNATI 27, OHIO

COMPLETE DIESEL PLANT

3—700 HP Winton 8 cyl. 4 cycle, 360 RPM diesels. 500 KW Elec. Mchy. 3/60/2300 alternators. Switchboards and complete plant auxiliaries. For sale in whole or part. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO
507 Locust St. St. Louis 1, Mo.

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL
"Expert Orders Carefully Executed"

BOILER UNITS

1—100,000# capacity, 330# Steam Generator, 83% efficiency.
3—400 HP B&W Sectional header 250#
2—70,000# 500 psi
2—50,000# B&W 450# superheat, air heater
2—1000 HP Stirling type Boilers 250#—super
2—650 HP B&W Stirling type Boilers
2—600 HP Stirlings 200#
3—510 HP & 2—318 Heinen 185#
1—500 HP B&W Steel Sectional Header Boiler
2—400 HP B&W Steel Sectional Header Boilers
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS

2—10,000 KW Turbo-Generator—Cond.
1— 7,500 KW Turbo-Generator—Cond. 600#
1— 5,000 KVA Turbo-Generator 450# with condens.
2— 5,000 KW Turbo-Generator—Cond.
2— 3,000 KW Turbo-Gen. and Cond., one aut. extrac.
2— 2,500 KW Turbo-Generators and Condensers
2— 2,000 KW Turbos & Condenser
2— 1,500 KW Turbos & Condenser
2— 1,250 KW Turbos & Condenser
2— 1,000 KW, also 750 & 500 KW Units, Condens.
Non-Cond. 1—350—500—750—1000—1500—2500

Frequency Changers—Motor-Generators & Diesel-Generators

TRANSFORMERS! Quick Delivery, Various Sizes Rebuilt like NEW—Guaranteed.
Send us your INQUIRIES for ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. NEW YORK 7, N. Y.

BOILERS

10 to 5000 H.P.
Diesel, Steam Turbine, Engine

GENERATORS

Heavy Power Equipment
Industrial — Chemical Process Equipment

UNUSED — RECONDITIONED

DEAN G. STRICKLER & ASSOCIATES
1346 Connecticut Avenue, N.W.
Washington 6, D. C. • DuPont 3386

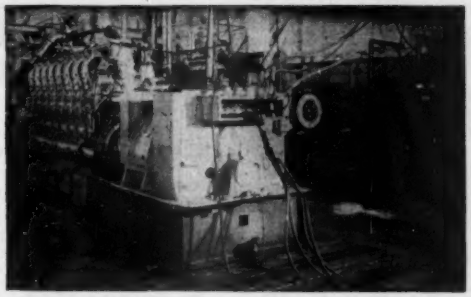
DIESEL POWER

AT 40% TO 60% SAVINGS

EACH ENGINE "REMANUFACTURED"
AND "FULL-LOAD TESTED"
PRIOR TO SHIPMENT

INSPECTION INVITED

ALL EQUIPMENT OFFERED WITH ONE YEAR GUARANTEE



VIEW OF ENGINE TEST STAND FACILITIES AT OUR PLANT IN SAUSALITO (S.F.) CALIF. ALL ENGINE TESTING CONFORMS TO DIESEL MANUFACTURERS' STANDARD METHODS.

A PARTIAL LIST OF OUR INVENTORY

KVA	MAKE	MODEL	HP	RPM	KVA	MAKE	MODEL	HP	RPM
1875	Fairbanks Morse	33E16	2000	300	312.5	General Motors	8-268A	450	1200
1420	Fairbanks Morse	38D	1600	720	312.5	Clark	GD-4	375	327
1250	General Motors	16-278A	1600	720	300	Fairbanks Morse	YVA	360	257
1000	General Motors	12-278A	1200	720	250	General Motors	8-268A	350	1200
937.5	General Motors	12-567	1080	720	237	Ingersoll-Rand	S	255	600
625	Alco	6-12½x13T	750	600	200	Buckeye	80	240	600
625	General Motors	8-567	720	720	156	Buckeye	E	190	400
425	Baldwin	VO	510	450	125	General Motors	3-268A	150	1200
400	Buckeye	80	480	600	75	General Motors	6-71	90	1200
375	Enterprise	DSG-6	450	450	62.5	Int'l Harvester	UD-18	76	1200
330	Superior	KNA	396	514	50	General Motors	4-71	60	1200

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American Brown Boveri 3 ph. 60 cycle O.I.S.C. outdoor 6000 KVA POWER TRANSFORMER, Serial #109408. 24,000 Volt delta to 5040 volt or 4800 volt wye. High voltage-oil immersed cable pothead entrance with 3-position gang-operated oil immersed disconnect switch. Low voltage-petrolatum or oil immersed cable pothead entrance. Transformer was new in 1929 and has been in continuous municipal storm water pumping duty to December, 1950. *Inquire*

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Purchasing Dept.
900 WATER BOARD BLDG.
DETROIT 26, MICH.

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COMPLETE WITH SWITCHBOARDS
1000 KW to 100 KW
STATIONARY and PORTABLE
AT GREATLY REDUCED PRICES
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USED TRANSFORMERS
REWOUND
REBUUILT
RECONDITIONED

MOTORS — M.G. SETS — TRANSFORMERS

SQUIRREL CAGE MOTORS
3-Ph., 60-Cy.

Qu.	HP	Make	Type	Volts	RPM
1	400	G.E.	IK	2200	514
1	400	G.E.	RT-412	2300	450
1	250	Whse.	CS	2200	1180
1	200	Al.Ch.	AR	220/440	580
2	125	Al.Ch.	AR	2200	1750
1	125	Whse.	CS-761	440	1750
1	125	G.E.	RT-448	2300	871
2	125	C.W.	126Q	440	430
3	100	Whse.	CS-663	440	1750
1	100	Al.Ch.	AR-226	2200	1160
1	100	Al.Ch.	AR	550	690
1	100	F.M.	H-241B	440	450
1	100	Whse.	CS-938	2200	514

SYNCHRONOUS MOTORS
3-Ph., 60-Cy.

Qu.	HP	Make	P.F.	Volts	RPM
1	1500	Whse	.8	2200	720
1	700	G.E.	.8	2300	720
1	400	Whse	.8	440	600
1	288	Al.Ch.	1.	2200	900
1	150	G.E.	1.	2200	900
1	150	G.E.	.8	550	450
1	150	G.E.	.8	2200	600
3	125	El.Mash.	1.	4800/2400	900
1	125	G.E.	.8	2200	900
3	100	Whse	.8	440	1800
1	100	Whse	1.	2300	1200
1	100	Ideal	.8	440	900
2	100	G.E.	.8	440	600

With the above we can supply manual, semi-magnetic or full magnetic, reduced or full voltage control.

SLIP RING MOTORS—CONSTANT DUTY—3-Ph., 60-Cy.

Qu.	HP	Make	Type	Volts	RPM
1	2000	G.E.	MT	2200	356
2**	1000	Al.Ch.	ANY	2200	235
2	500	G.E.	1-16-M	2300	450
1	500	Whse	CW	2300	514
1	500	Al.Ch.	ARY	2300	504
1***	400	G.E.	MT-574	550	585
1**	400	G.E.	I-M	2300	590
1**	400	Al.Ch.	ANY	2200	505
2	400	G.E.	IK	2200	514
1	300	G.E.	I-E15-M	2200	1200
1	200	Al.Ch.	ARY	2200	505
1	250	G.E.	MT-414	2200	300
1	200	G.E.	I.M.	2200	585
1	150	G.E.	I-E13-M	2200	1750
1	150	Whse	CW	2300	600
1***	125	Whse	CW-870	2300	900
1	100	F.M.	420-C	440	900
1	75	G.E.	I.M.	440	695

** Mill type pedestal bearing. *** 3-bearing.

MOTOR GENERATOR SETS

Qu.	KW	Make	R.P.M.	Volts DC	Volts AC
1	2400(3-U)	Al.Ch.	720	600	4800/240
1	1500	Whse	514	250	4800/2300
1	1500(3-U)	Al.Ch.	720	600	2200
1	1500	Whse	720	600	2200
2	1000	G.E.	514	575	4000/2300
1	750	Whse	900	600	2300
1	700(3-U)	G.E.	720	250	2300/440
1	500(3-U)	Whse	1200	120/240	4000/2300
1	500(3-U)	Ideal	1200	120/240	4000/2300
1	500	C.W.	720	575	2300/440
2	500	C.W.	720	250/275	2300/440
1	200	Ridgway	900	275	2300
1	155	G.E.	720	250	2300/440
1	150	Al.Ch.	1200	250	2200/440
1	100	Ridgway	1200	275	4000/2300
1	85	C.W.	1200	250	2300/440
1	75	Star	1200	230	440/220
1	75	Al.Ch.	900	250	2300
2	50	Burke	1800	240	440/220
1	45	Whse	1200	125	440/220
1	30	Reliance	1800	250	440/220
2	25	Whse	1200	120/240	440/220
1	20	Reliance	1800	250	440/220

3-U—3-unit set.

We can also furnish any of the above with exciters and VARIABLE VOLTAGE CONTROL engineered and rebuilt to suit your requirements.

ROTARY CONVERTERS

2025/2565 K.W. 225/285-V D.C., G.E., 9000 Amp., 450-R.P.M., with booster.

2760—K.V.A. Trans., 6900-V, 3-PH., 60 CY., complete control & C.D. distribution cubicles.
Will Rewind Transformer to Suit Your Current.

TRANSFORMERS—(OIL COOLED)

Qu.	K.V.A.	Make	Type	Phase	Voltage
1	7500	G.E.	H	3	23000/29700 13800/12600
2	4500	G.E.	H.T.	3	27000/13500 2300
1	3750	Whse	S	3	67000–14400/2400
3	500	G.E.	H	1	13200/11880 220/440
3	130	G.E.	H	1	19000/9500 550/2200
3	100	Whse	Auto	1	2300/5160 1385/2400
3	100	Whse	S.S.	1	12075/10955 230/460
2	50	Wagner	H.E.	1	13200/11880 575/285
3	50	Al.Ch.	OISC	1	22000 220

DIRECT CURRENT MOTORS

Qu.	HP	Make	Type	RPM
1***	3000	Whse	Encl(Rev)	600
1***	2400	Whse	Encl(Rev)	600
6***	1800	Whse	Encl(Rev)	600
4***	1200	Whse	Encl(Rev)	600
1***	1250	Whse	Mill(Rev)	300/600
4***	800	Whse	Encl(Rev)	600
1	350	G.E.	CD169	1150
1	325	Whse	QM	450/900
1	200/250	El.Dy.	No. 22	400/1200
1	200	Whse	Mill(Rev)	300/1200
1	180	G.E.	MPC	400
1	150	Al.Ch.	Mill(Rev)	400/1200
1*	150	C.Wh.	83H	890
2***	125	Whse	8K-190	600
1	100/125	Rel.	1095F	300/1200
2	100	Rel.	1050T	400/1200
1	90/160	G.E.	MPC	625/1125
1*	80/75	Rel.	1095F	300/1200
1	50	G.E.	RF16	300/900
1*	30/75	Whse	8K151L	400/1200
1	40	Al.Ch.	E127	850/1750
1	35	G.E.	CD125	400/1200
1	35	G.E.	CD147	300/1200
2	33	G.E.	RF14	800/1500
1	33	Rel.	T	250/1000
1	32½	Whse	8K150	400/1200
1	30	G.E.	CDM105	875/1750
2	27½	El.Dy.	158	450/1350
1	25	G.E.	RF13	400/1800
2	25	G.E.	CD122	400/1200
1	25	Whse	8K111L	250/1000
3	20	Al.Ch.	E130	400/1200
1	20	Whse	8K120	375/1500
3	20	G.E.	CD123	300/1200

Above are all 230 VDC except where marked ***.
*** Pedestal Bearing 525/600 VDC Mill Design Rev. (designed for mill reversing service). *T.E.F.C

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4314 CLARISSA STREET — Phone DAvenport 4-8300 — PHILADELPHIA 40, PENNA.

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General Electric 50 Ton, 500 Volt, D.C. Electric Locomotive with catenary equipment, rotary convertor, substation, 3½ miles of trolley. $4,000 worth of spare parts.

Price $12,000.00

In operation until July 1951.

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116 Third Ave., North

Minneapolis 1, Minn.

PUMPS—COMPRESSORS—BLOWERS

1—2000 GPM 350' Pump with 240 HP Turb.
1—750 GPM 231' Pump with 75 HP 3 ph. motor
2—675 GPM 428' Pumps with 125 HP Turb.
1—300 GPM 356' Pump with 50 HP 3 ph. motor
1—200 GPM 556' Pump with 50 HP Turb.
1—1100 GPM 229' Al.-Ch. Cent. Pump
4—2000-5000 GPM 32'-65', 10" & 12" Pumps
1—1000 GPM 280' all-bronze Cent. Pump
4—Kinney unused 6" Rotary Pumps
3—Blackmer 6" Rotary Pumps 500 GPM
3—750 & 1000 GPM Knowles Steam Pumps
1—6" x 10" & 1—7" x 10" Triplex Pumps
1—5" x 8" Galland Hydraulic Triplex Pump
1—6" x 10" Gardner duplex Pump 300 GPM
1—12" x 14" Duplex Air Compressor 550 CFM
1—12"x16" I-R Air Compressor 355 CFM
2—12"x9" Worth. Comp. 375 CFM, Vac. & Press.
1—4-stage Nerwalk Compressor 28 CFM 5000 PSI
1—Sturt. 60 H.P. Tur.-Blower 7000 CFM 28 oz.
1—GE 2-stage Turbo Blower 3000 CFM 16 PSI
1—Spencer 30 H.P. Tur. Blower 4000 CFM 16 oz.
1—60 H.P. DC 230 v. 1150 RPM comp. C-W Motor
1—50 H.P. DC 230 v. 1750 RPM unit.-bear Motor
10—Nash Vacuum Pumps and Vac.-Heating Units
250—Rebuilt Motors 1—200 H.P.
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HUNDREDS OF OTHER ITEMS—ALL SIZES—ALL MAKES

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MOTOR: 135 HP Sync. 3/60/4000 volts/.8 p.f./1200 r.p.m./Type TS/FR963Z.

GENERATOR: 90 K.W., 1500 Amps., 60 volts, Type CD, FR 1251

Above are complete with AC starting equipment and DC panels. Will rewind for 100 KW, 250 volts upon order.

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ALL MAKES — ONE QUALITY

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SPECIAL TIMKEN BEARING UNITS

CFM	P.S.I.	MFG. & SIZE	
594	20	INGERSOLL—ESI	15x 9
294	125	CHICAGO T-B	10x11
262	75	INGERSOLL ESI	10x 9
211	100	WORTHINGTON HB	9x 9
211	100	INGERSOLL ESI	9x 9
166	135	INGERSOLL ESI	8x 9
122	100	WORTHINGTON HB	7 x7

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2—404 H.P. Springfield sectional header
1—250 H.P. Stirling, Class-H. Coxe Stoker
2—400 H.P. built in 1942 (used 3 years) COMPLETE PLANT, forced & induced draft fans, stacks, Spreader stokers & oil burners.

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34-23 91st STREET, JACKSON HEIGHTS, N. Y.

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY

Jackson, Miss.

220/440 Volt, 60 cycle **SQUIRREL CAGE** open, 3 Phase

GUARANTEED REBUILT

QN.	HP	MAKE	TYPE	BEARING	SPEED
1	200	G.E.	IK	S.B.	900
1	200	G.E.	IK	S.B.	720
1	150	G.E.	IK	S.B.	900
1	150	G.E.	IK	S.B.	720
1	150	G.E.	IK	S.B.	1800
2	125	Kilsa		S.B.*	1800
1	100	West.	MB	S.B.	1200
1	100	West.	CB	S.B.	720
2	100	G.E.	IK	S.B.	720
1	100	G.E.	KT-347	S.B.	1200
2	100	G.E.	IK	S.B.	900
1	100	G.E.	IK	S.B.	1800†
3	100	G.E.	IK	S.B.	1800
1	100	West.	CS-504	S.B.	1800
1	75	G.E.	IK	S.B.	900
2	75	G.E.	IK	S.B.	720
2	75	West.	CS-752C	S.B.	900
1	75	G.E.	K-505	S.B.	1200
1	75	G.E.	IK	S.B.	1800†
2	75	G.E.	IK	S.B.	900
4	75	West.	CS	S.B.	1200
4	75	G.E.	IK	S.B.	1200
2	75	F.M.	QS-445	S.B.	1800

QN.	HP	MAKE	TYPE	BEARING	SPEED
2	75	G.E.	IK	S.B.	1800
1	60	G.E.	KT-340	S.B.	900
1	60	G.E.	IK	S.B.	1200
1	60	F.M.	QS-444	S.B.	1800
1	60	G.E.	KT-333	S.B.	1800
4	60	G.E.	IK	S.B.	1800
1	50	G.E.	IK	S.B.	900
3	50	West.	CB	S.B.	900
1	50	G.E.	KT-342	S.B.	900
1	50	G.E.	KT-342	S.B.	900†
2	50	West.	CS-445	S.B.	1200
1	50	G.E.	KT-327	S.B.	1800
2	50	G.E.	IK	S.B.	1800†
3	50	G.E.	IK	S.B.	1800
1	40	G.E.	KT-342	S.B.	720
1	40	F.M.	BH12D	S.B.	900
1	40	G.E.	KT-338	S.B.	900
1	40	West.	CB	S.B.	1200
1	40	G.E.	IK	S.B.	1800†
2	40	G.E.	IK	S.B.	1800
1	35	G.E.	IK	S.B.	720
1	35	Triumph	B12	S.B.	900
3	30	G.E.	KT-312	S.B.	1800

QN.	HP	MAKE	TYPE	BEARING	SPEED
3	30	G.E.	IK	S.B.	1800
5	30	West.	K-305	S.B.*	3600
1	25	G.E.	IK	S.B.	720
1	25	F.M.	B12P	S.B.	720
1	25	Century	SC-30	S.B.	1200
1	25	F.M.	BH12A	S.B.	1200
1	25	Ideal	A 18	S.B.	1200
1	20	West.	CS-471	S.B.	1800
1	20	F.M.	KBV	S.B.	1200
1	20	G.E.	KT-322	S.B.	1200
1	20	G.E.	KT-312	S.B.	1200
1	20	G.E.	K-364	S.B.	1800
1	20	West.	CS-364	S.B.	1800
2	20	G.E.	K-328	S.B.	3600
4	20	Line-Weld	Frame 328	S.B.	3600
2	15	West.	CB	S.B.	720
1	15	Wagner	15 T	S.B.	1200
1	15	Ideal	A	S.B.	1200
1	15	G.E.	KT-302	S.B.	1200
1	15	G.E.	KT-752	S.B.	1800
1	10	G.E.	IK	S.B.	1200
1	10	G.E.	KT-752	S.B.	1200

* Splash proof † 2300 volt

SLIP RING MOTORS

We offer from stock the following 220/440 volt, 60 cycle, 3 phase, GUARANTEED REBUILT equipment, unless otherwise noted.

QUAN.	H.P.	MAKE	TYPE	SPEED	DESCRIPTION
1	15	G.E.	MT 512	900	S.B.
1	30	G.E.	MT 332	900	
1	20	Al. Ch.	ANY	900	
2	40	Al. Ch.	ARY 444	1800	splash proof, S.B.
1	40	G.E.	MT 338	900	S.B.
1	50	G.E.	I-M	900	S.B.
2	80	G.E.	MT 556	900	
1	90	G.E.	MT 345	900	
1	80	G.E.	I-M	900	
1	80	West.	CW 505	1200	
1	75	G.E.	I-M	720	
1	100	G.E.	I-M	720	
1	100	G.E.	I-M	900	
1	125	G.E.	I-M	720	
1	150	G.E.	I-M	900	
1	150	G.E.	I-M	1800	2300 volt
1	200	G.E.	I-M	900	

TOTALLY ENCLOSED MOTORS

FAN COOLED, BALL BEARING, 220/440 volt, 60 cycle, 3 phase, GUARANTEED REBUILT, unless otherwise noted.

QUAN.	H.P.	MAKE	TYPE	SPEED	DESCRIPTION
1	7½	G.E.	KF 284	1800	
1	7½	Reliance	AA 324	1200	XP, NEW
3	10	L.A.	JB 328	1200	
1	15	West.	CB 328	1800	XP, NEW
1	25	L.A.	JB 384	1800	
1	40	G.E.	K 486	1800	XP, NEW
1	50	Master	FB 484	3600	XP, NEW
1	80	Al. Ch.	ARZZ 444	1800	NEW
1	75	G.E.	K 580	1200	

POWER EQUIPMENT COMPANY

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Telephone: Genesee 5629

MOTOR GENERATOR SETS

125 K.W. 230 Volt D.C. Burke 440 Volt 3 phase 60 cycle 900 RPM Synchronous Motor.

100 K.W. 250 Volt D.C. Gen. Elec. 3 brg. 440 Volt 3 phase 60 cycle 900 RPM. Synchroneous Motor.

50 K.W. 250 Volt D.C. Westing. 4 brg. 220/440 Volt 3 phase 60 cycle 120 RPM motor.

20 K.W. 125 volt D.C. Allis Chalmers 3 brg. 440 volt 3 phase 60 cycle 1800 RPM motor.

D. C. GENERATORS

100 K.W. 230 volts 1200 RPM Westinghouse SK

75 K.W. 250 volts 600 RPM Westinghouse SK

MOTOR REPAIR & MFG. CO.

1557 Hamilton Ave., Cleveland, Ohio

TRANSFORMERS

FOR SALE

2— 150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6— 100 KVA. 60 CY. 1 PH. 2400-240/120.
8 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

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BOILERS

10 to 1000 H.P.

NEW-USED
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Steam, Gas and Electric Power Equipment

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MURRAY HILL 7-6547-8-9

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Diesel Gasoline and Steam Generators, Electrical and Industrial Equipment

POWERITE CORPORATION

140 Cedar St. New York 6, N. Y.
Dept. 105 BA 7-8199

MOTORS FOR SALE

2—General Electric, Type B.T.A., frame 552, 75/18.5 HP, adjustable speed, 1070/267 RPM, 3 phase, 60 cycle, 208 volt, semi-enclosed, externally ventilated motors, in excellent condition.

ELECTRIC ENTERPRISE CO.

88 Waite St., New York 13, N. Y.

2—ELLIOT TURBINE GENERATOR SETS

GEN: 250 KVA, 3/60/208V/.8PF/1200 RPM
TURBO: Non Cond. 200# PR, 100° Super Heat w/Switchboard, EXCELLENT CONDITION
1—UNUSED 450 HP G.E. 3/60/2200V/1200 RPM Type KF, ser. #6338852 Vertical.
3 PHASE 60 CYCLE SLIP RING MOTORS
1—30/GE/MT342/220V/690 RPM/4002427
1—40/GE/HT346/220V/690 RPM/4012815
1—40/AL CH/440V/900 RPM/Ball Brg.
1—50/GE/MT05542/440V/540 RPM/4560343
3—50/GE/MT552/2200V/695 RPM/5241679
1—60/GE/MT346/440V/855 RPM/1469595

ALBERT HELLER CO.

210 Sackett Ave., Brooklyn, N. Y.
HYacinth 5-0800

FOR SALE — TRANSFORMERS

LATE TYPE MOLONEY SINGLE PHASE. 60 CYCLE H.V. 7200/12470 Y, L.V. 120/240
4—3KVA 11—15KVA, 9—10KVA 49—25KVA, 4—37½KVA

WE ALSO HAVE IN STOCK THE FOLLOWING:

Qu.	KVA	Make	Type	Phase	Voltage
3	200	Moloney	C	1	44000/22000—440/220
3	30	W.E.	A	1	1100/2300—110/220
8	25	G.E.	H	1	2300/3180Y—122/244
2	25	G.E.	H	1	2300—244/488
2	25	G.E.	H	1	2400/4160—120/240
2	25	G.E.	HS	1	2400/4160—120/240
1	25	A.C.	PBSR	1	2400—120/240
5	15	G.E.	H	1	2300/3815Y—244/488
3	15	G.E.	H	1	2400/4160Y—120/240
6	15	G.E.	H	1	2300/2090/1980—244/488
3	15	Moloney	HE	1	1100/2200—240/480
3	10	G.E.	H	1	2200—110/220
2	7½	A.C.	ODSC	1	2200—220/440

AVAILABLE FOR INSPECTION AT OUR WAREHOUSE

PHONE ★ WIRE ★ WRITE

GAVENDA BROTHERS INC.
CANTON, ILLINOIS PHONES 739 & 2438

BOILERS, TURBINES, EQUIPMENT

1—65,000 lbs. per hr. BOILER, 450# pressure. Complete with all fixtures and trim, sectional steel header, straight tube type.

6—600 H.P. B&W BOILERS, 200# pressure, Straight tube type.

The above boilers are ready for delivery in April and August.

1—100,000 lbs. per hour BOILER, 650# pressure, complete. Delivery in July.

Turbo-Generators, Power Equipment, M.-G. Sets, Diesel Engines, etc.

HOWE BROTHERS
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One Combustion Engineering Co., Electric Steam Generating Unit, A.S.M.E. Code, Kaelin Type, 500 HP, 250 PSI, 5000 KW, 2300 Volts, 3/60, consisting of Main Drum with 3 Electrodes, Large Code Accumulator, control panel, pump, safety, blowdown and feed valves, with piping as removed from service. Built in 1945, installed 1946 and used intermittently short time. Condition excellent. Offered at big saving and immediate stock delivery. *Write or phone for complete details.*

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411 HP 200# ALL NEW TUBES
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1—Terry, type C-2, 750 HP @ 1500 RPM (467 HP @ 1500 RPM w/hand valves closed) 150# steam @ 50° F.S.H.

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220/440 volt 3 ph. 60 cy.

Qua.	HP	Make	RPM	Type
1	250	Burke	720	syn. (2300 v.)
1 vert.	250	G.E.	1175	I-E. 15 s.
1	250	G.E.	1175	(2200 v.)
5	250	Westg.	1775	CS-8758 drip proof
5	200	Wagner	1750	RP-2
1	200	G.E.	1800	syn.
1	150	Westg.	257	syn.
1	150	Westg.	900	CS-954A
4	150	Westg.	1150	CS drip proof
1	150	Westg.	1200	MS-hi-torq.
1	150	G.E.	720	1-K-564
1	125	Elec. Mach.	164	syn.
1	125	Westg.	450	CS-954-A
1	125	Westg.	600	syn.
4 New	125	Westg.	1200	syn.
1	100	Westg.	600	syn.
1	100	Westg.	900	syn.
1	75	Stanley	600	
1	75	Allis Chal.	585	
1	75	G.E.	720	1
1	75	G.E.	900	1-K
2	75	Elec. Mach.	900	syn.
1	75	Allis Chal.	1750	2200 v.
1	75	G.E.	1200	KT-346
1	60	Allis Chal.	514	
2 New	60	Westg.	900	CS-607 TEFC-X pr.
2	60	G.E.	1750	KT-533
1	60	Triumph	1200	B-123
1	50	Triumph	560	
3	50	Westg.	900	CS-550 v.
1	50	G.E.	900	KT-346
5 New	50	G.E. (T.E.F.C.—B.B.)	1750	K-504U
1	40	G.E.	570	KT-546
1	40	G.E.	720	KT-346
1	40	G.E. (Hi-torq.—hi-slip)	1630	KB-444
1	30	G.E. (hi-torq.)	790	KB-444
1 New	30	Westg. (Linestart—hi-torq.)	900	CS-445
2	30	G.E.	3600	KT-205
2	25/7.5	Continental	1150/575	
1	25/6.2	Continental	1150/575	
1	25	Howell	1200	SC
1	25	G.E.	1150	KT-322
1	23	Westg.	1160	CS-405
1 New	20	Reliance	580	C-445
1	20	G.E.	680	KT-5325
1	20/7½	G.E.	1165/825	K-504
1	20	L.A.	870	Ex.-405-exp. pr.

SLIP RING MOTORS

3 ph.—60 cy.

HP	Make	RPM	Type	Volts
600	G.E.	360	MT	2200
600	Ideal	1770		440
500	Ideal	1770	AVN	440
400	Westg.	428	HF	2200
300	Allis Chal.	505		2200
200	Westg.	900	CW	220/440
100	Triumph	588	C-17	550/220/440
75	G.E.	450	M-6325	220/440
60	Westg.	1160	CW-644C	220/440
60	G.E.	570	MTC-5346	220/440

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Diesel Engine Generator Sets

10—100 kw., 120/240 v. D.C. Delco Generators dir. con. to 150 HP Model GBD-8, 5½x17, 8 cyl. Superior DIESEL Engines, elec. start with engine panels

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1—66 kva. Fairbanks Morse 220/440 v. 3 ph. 60 cy. 300 rpm DIESEL.

2—75 kva. 220/440 v. 3 ph. 60 cy. Delco Cummins DIESEL

2—37½ kva., 220/440 v. 3 ph. 60 cy. Buda DIESEL

NEW SCIAKY SPOT WELDER

90 kw. Electric Resistance. Throat depth 34" total electrode stroke 1" work and 4" retraction capable of welding from 2 thicknesses of .032 to 2 thicknesses of .125 aluminum or other alloys or corrosion resisting steels.

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2—3 HP., 1750/3500 rpm 230 V D.C. Reliance.

3—7½ HP., 1750/2190 rpm 230 V. D.C. Reliance.

3—60 HP., 900 rpm., 220/440 v. 3 ph. 60 cy. Westinghouse CS-607.

NEW SINGLE PHASE MOTORS

110/220 v. 60 cy.

15—¾ HP G. E. 1145 rpm type KCJ-204, drip proof.
8—1½ HP Westg. 1725 rpm B.B. Type CAF-204.
8—2 HP Westg. 1160 rpm type CU-254.

MOTOR GENERATOR SETS—250 V. D.C.

Motors 220/440 volt or 2200 volt

No.	KW	Make	Rpm
2	200	Westinghouse	1200
1	160	Westinghouse	720
1	160	General Electric	900
1	150	Westinghouse	600
1	100	General Electric	1200
1	100	Reliance	580
1	100	Delco	1200

125 V. DC M.G. Sets

1—75 kw. West. 125 v. 1200 rpm. 220/440 v. 3 ph. 60 cy. Syn.

TRANSFORMERS

1 ph. 60 cy.

No.	Kva	Make	Primary	Sec.
3	200	Pgh.	4800	120/240
3	200	Allis Chal.	4800	120/240
2	150	Pgh.	2300	230/460
2	150	Pgh.	4800	115/230
1	110	Pgh.	4800	115/230
6	100	Pgh.	4800	115/230
2	100	Allis Chal.	4800	120/240
3	100	Wagner	4800/2300	230/115
2	100	G. E.	4800	120/240
1	75	Pgh.	4800	115/230

ENGINES

NEW 75 HP. P.&H. Model 38C 3 cyl. Diesel
Rebuilt 32 HP. Caterpillar Model D-3400 Diesel
NEW 45 HP. International Model U-6 4 cyl.

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20—6000 cfm Sturtevant Bulletin 512389 3" stat. pres. 7 blade dir. con. 5/1.5 HP 1765/1175 rpm 220/440 v. 3 ph. 60 cy. Westg. TEFC Motors
5—5000 cfm 3.2" stat. pres. Sturtevant with 2 speed 220/440 v. 3 ph. 60 cy. Motors
2—10,000 cfm LADEL dir. con. 2 speed 220/440 v. 3 ph. 60 cy. Motors
1—13000 cfm 3" stat. pres. with 2 speed 220/440 v. 3 phase 60 cy. Motors
2—16000 cfm 3" stat. pres. Buffalo Forge with 2 speed 220/440 v. 3 ph. 60 cy. Motors
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STerling 3-6515

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3—600 KW INGERSOLL RAND 2400 V. NEW 1949
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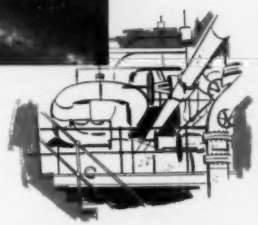

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